IN-DEPTH REVIEW
BRIEFING BOOK

SUSTAINABLE AGRICULTURAL SYSTEMS LABORATORY
Animal and Natural Resources Institute
Beltsville Area
ARS-USDA

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Sustainable Agricultural Systems Laboratory

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9:30	General Session - Opening Remarks **Tom Sexton**, Institute Director, Animal and Natural Resources Institute
9:40	Overview of SASL Program **John Teasdale**, Research Leader
10:00	Microbial Approaches to Enhance Biological, Chemical and Physical Properties of Soil (Project 1265-12000-025) **Jeff Buyer**, Lead Scientist
10:20	Break
10:35	Biological Technologies as Alternatives to Chemicals for Control of Soilborne Pathogens (Project 1265-21220-176) **Dan Roberts**, Lead Scientist
10:55	Enhancement of High Value Cropping Systems through Management of Cover Crops (Project 1265-21000-138) **Aref Abdul-Baki**, Lead Scientist
11:15	Long-Term Field Experiment to Evaluate Sustainability of Organic and Conventional Cropping Systems (Project 1265-21660-001) **Michel Cavigelli**, Lead Scientist
11:35	Development of Biological Control Agents for Weeds (Project 1265-21220-162) **John Lydon**, Lead Scientist
11:55	Executive Session II Review Team and Invited Guests
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Wednesday Afternoon, March 12 to Thursday Afternoon, March 13
Interviews with Individual Scientists and Staff
Building 001, Room 324

1:30 PM	**Jeff Buyer**
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3:45	**Pat Millner**
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Thursday, March 13, 2002

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11:35	**John Teasdale**
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1:15 PM	**Ben Coffman/Mark Davis**
1:55	Permanent Support Staff
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3:30	Report Preparation by Review Team

Friday, March 14, 2002
Morning Session, 8:30 to 11:30
Building 011A, Room 119

8:30 AM	Executive Session III Review Team, Area Management Team, National Program Leaders
10:00	Break
10:15	General Session Review Team, SASL Staff, Area Team, and NPLs
11:30	Adjourn

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Parochetti, James	National Program Leader, Plant and Animal Systems, CSREES
Thomas, Bill	Alternative Farming Systems Information Center, NAL

MISSION

The Sustainable Agricultural Systems Lab (SASL) develops principles and practices to support the achievement of sustainable agricultural systems. The concept of sustainability includes the production of ample, safe, and profitable products while preserving natural resources, maximizing reliance on natural processes, and enhancing quality of life. SASL consists of a multi-disciplinary team of microbiologists, soil ecologists, weed scientists, plant physiologists, plant breeders, and economists that approach research problems from a systems rather than a disciplinary approach. Emphasis is placed on understanding fundamental agroecological processes and identifying diverse approaches to achieving sustainability rather than promoting any particular form or philosophy of agriculture. Communication with the community of growers, suppliers, information specialists, and consumers that value sustainable agriculture is integral to the definition of research problems and the transfer of technology by SASL personnel.

HISTORY

An ad hoc program in sustainable agriculture was developed at the Beltsville Agricultural Research Center in the early 1990's. A "grass-roots" collaboration of scientists from several laboratories and institutes with interest in sustainable farming systems initiated this program. This research was based on a diverse set of projects including cover crop management, manure management, composting and utilization of waste materials, biologically-based weed and pest management, and economic and environmental assessment of sustainable systems. The Beltsville Area Office was highly supportive and facilitated these efforts through 1) funding the expansion of projects, 2) upgrading farm equipment, 3) creating two long-term cropping systems sites, the Sustainable Agriculture Demonstration and the Farming Systems Project, 4) establishing the Compost Facility, and 5) supporting annual summer field days and winter symposia.

In October of 2000, selected aspects of this program were institutionalized and highlighted through a reorganization that created several new laboratories. The Sustainable Agricultural Systems Laboratory was created with scientists from six previous laboratories: Soil Microbial Systems, Weed Science, Vegetable, Biocontrol of Plant Diseases, Climate Stress, and Remote Sensing and Modeling. During the past two years, nine CRIS projects have been consolidated into five projects while staff and equipment have been consolidated from several buildings into primarily one, Building 001. Of these five projects, two projects have been accepted by the ARS Office of Scientific Quality Review (OSQR). Prospectuses for two other projects have been approved and project statements will soon be submitted to OSQR for review during summer of 2003. The fifth project will be reviewed in 2004.

This is the first In-Depth Review of this laboratory since its inception.

PROJECT LISTING

1265-12000-025
Microbial Approaches to Enhance Biological, Chemical and Physical Properties of Soil

Investigators:

Jeffrey S. Buyer (Lead)	100%
Sara E. Wright	100%

Scientific Staff Years: 2.00
Funding: $542,632 plus $40,000 for one HQ funded Research Associate, C. Blackwood.
National Program: 202 Soil Resource Management
OSQR Status: Approved.

Start Date: 6/9/2001 Termination Date: 6/8/2006

Objectives (Final Project Plan):
Our overall objective is to utilize soil microbes to improve soil properties. The first area, soil microbial communities and ecology, focuses on soil biology and biochemical functions of the ecosystem. The second area, glomalin, focuses on enhancing soil physical properties through microbiology. While all of these projects are distinct from one another, together they use microbiology to address a broad range of issues in soil management.

1. Develop improved methods to characterize soil microbial communities, including high-sensitivity analysis of fatty acid methyl esters, substrate utilization and MPN assays for chemolithotrophs and anaerobes, use of ecologically relevant carbon sources in the substrate utilization assay for heterotrophs, and fatty acid analysis of substrate utilization assay cultures.

2. Study the interactions between soil, root, seed, and microbial communities and develop strategies to improve colonization of root and seed by beneficial microorganisms.

3. Define the structure of glomalin.

4. Determine the effects of management practices on mycorrhiza and glomalin, and the effects of glomalin and mycorrhiza on soil chemical and physical properties.

1265-2122–176

Biological Technologies as Alternatives to Chemicals for Control of Soilborne Pathogens

Investigators:

Daniel P. Roberts (Lead)	80%
Patricia D. Millner	40%
Aref A. Abdul-Baki	20%

Scientific Staff Years: 1.40
Funding: $465,968
National Program: 308 Methyl Bromide Alternatives
OSQR Status: Approved.

Start Date: 10/9/2002 Termination Date: 10/9/2007

Objectives (Final Project Plan):

1. Develop biological controls for important soilborne pathogens of tomato, pepper, cucumber, and strawberry.

2. Determine factors important in the introduction, establishment, and persistence of biocontrol agents in various rhizosphere environments.

3. Develop compost management technologies to improve suppression of soilborne pathogens of strawberry, tomato, pepper, and cucumber.

4. Develop a reduced-tillage, low input system as an alternative to methyl bromide for winter production of fresh-market tomatoes and Bell pepper in Florida.

1265-21000-138

Enhancement of High Value Cropping Systems through Management of Cover Crops

Investigators:

Aref A. Abdul-Baki (Lead)	60%
Thomas E. Devine	100%
Donald T. Krizek	100%
C. Benjamin Coffman	25%
John R. Teasdale	25%
Daniel P. Roberts	20%

Scientific Staff Years: 3.30
Funding: $1,065,976
National Program: 207 Integrated Agricultural Systems
OSQR Status: Prospectus approved, Plan in preparation, Panel convenes July, 2003.

Start Date: 7/18/1999 Termination Date: 7/17/2004

Objectives (Prospectus):

1. Develop cover crop management practices to maximize efficient use of cover crop residues and nutrient release for vegetable production.

2. Integrate cover crops with season-extending high tunnels to optimize market and profit potential of high-value crop production.

3. Determine rhizosphere communities on tomato plants grown in hairy vetch and rye cover crops.

4. Breed and evaluate new cultivars of (a) hairy vetch for use as a cover crop, (b) grain type soybeans with enhanced crop residue production to reduce soil erosion and (c) tall, large-seeded vegetable soybean cultivars for small and organic farmers.

5. Develop low-input, no-tillage cover cropping systems for date palm orchards of hot, arid, southeast California and for sugar apple orchards of subtropical south Florida.

1265-21660-001
Long-Term Field Experiment to Evaluate Sustainability of Organic and Conventional Cropping Systems.

Investigators:

Michel A. Cavigelli (Lead)	100%
Yao-Chi Lu	70%
C. Benjamin Coffman	25%
John R. Teasdale	25%
Patricia D. Millner	20%
Larry Sikora	15%

Scientific Staff Years: 2.55
Funding: $1,008,326 plus $80,000 for HQ funded Research Associates S. Ullrich and S. Green.
National Program: 207 Integrated Agricultural Systems (60%)
202 Soil Resource Management (40%)
OSQR Status: Prospectus approved, Plan in preparation, Panel convenes July, 2003.

Start Date: 7/23/1999 Termination date: 12/31/2003

Objectives (Prospectus):

1. Evaluate crop performance, soil fertility, soil quality, weed population dynamics and other measures of agronomic performance among five cropping systems in a long-term project, the Farming Systems Project (FSP).

2. Determine and understand mechanisms controlling carbon, nitrogen, and phosphorus dynamics, retention, losses and budgets among five cropping systems in the FSP.

3. Understand the processes controlling soil biological activity and community structure among five cropping systems in the FSP.

4. Predict the long-term sustainability of cropping systems for economic viability, environmental protection, and efficient use of natural resources under future environmental and economic scenarios.

1265-21220-162
Development of Biological Control Agents for Weeds

Investigators:

John Lydon (Lead)	100%
C. Benjamin Coffman	50%
John R. Teasdale	50%

Scientific Staff Years: 2.0
Funding: $660,688
National Program: 304 Crop Protection and Quarantine (Weed Science)
OSQR Status: Panel Convenes December, 2004.

Start Date: 3/25/1999 Termination Date: 3/24/2004

Objectives:

1. Improve the activity of biological control agents on economically important weeds, thus reducing the dependency on agricultural chemicals to control weeds.

2. Identify and isolate bacterial genes that code for phytotoxin production and transform bacterial biological control agents of weeds with phytotoxin production genes.

3. Determine the responses of weed populations to cover crops and cultural practices in sustainable production systems.

Extramural Projects

1265-21220-176-02S (Specific Cooperative Agreement with Virginia Tech)
Evaluation of Plant-Beneficial Bacteria for Use in Integrated Pest Management Strategies
Investigator: Daniel P. Roberts
Start: 9/1/2000 Termination 8/31/2004

1265-21220-176-03S (Specific Cooperative Agreement with U. of Florida, Homestead)
Development of Biologically-Based Sustainable Winter Vegetable Production Systems
Investigator: Aref A. Abdul-Baki
Start: 9/1/2001 Termination 8/31/2003

1265-21660-001-01S (Specific Cooperative Agreement with U. of Maryland, Geography Dept)
Development and Analysis of Geographical Database Defining Organic Agroecosystems
Investigator: John R. Teasdale
Start: 9/1/1999 Termination: 8/31/2004

1265-21660-001-02R (Reimbursable IFAFS grant with Maryland Extension)
Bridging the Urban-Rural Divide: Marketing Local Foods
Investigator: John R. Teasdale Funding: $143,535
Start: 7/1/2001 Termination: 9/30/2003

1265-21220-176-01R (Reimbursable IPM grant with Michigan State University)
Cultural and Biological Alternatives to Methyl Bromide Fumigation of Strawberries
Investigator: Patricia D. Millner Funding: $77,490
Start: 10/10/2000 Termination: 9/30/2004

Trust Agreement with Hankook Bioceramics
Development of Biological Controls for Suppression of Select Soilborne Diseases of Cucumber
Investigator: Daniel P. Roberts Funding: $20,000
Start: 4/1/2001 Termination: 3/31/2003

ACCOMPLISHMENTS BY CRIS PROJECT

1265-12000-025
Microbial Approaches to Enhance Biological, Chemical and Physical Properties of Soil

Soil type is more important than plant species in determining rhizosphere microbial communities. Many biocontrol bacteria need to colonize the spermosphere or rhizosphere in order to function. This requires successful competition with the indigenous microbial community. Identification of the factors controlling microbial community structure is a necessary step in developing novel strategies to maximize colonization and improve biocontrol of fungal pathogens such as *Fusarium*, *Verticillium*, and *Pythium*. Rapidly growing aerobic heterotrophic bacteria, which make up a very small percentage of the total community, were affected by plant species, but the soil type was far more important than plant species in determining the composition of the total microbial community. **Role:** Dr. Buyer conceived and carried out the experiments and wrote the manuscripts. **Impact:** This work demonstrated that the soil is more important than the plant in determining soil and rhizosphere microbial communities, and that the classic view of the 'rhizosphere effect' may be exaggerated. This means that colonization studies with potential biocontrol agents need to be carried out in a wide variety of soils, and that efforts to improve colonization need to focus as much on soils and indigenous communities as on the plant species to be colonized. This research also compared two widely used assays for microbial communities, and demonstrated that the substrate utilization assay may not be measuring community function, as previously believed, but instead is measuring the community structure of culturable aerobic heterotrophic bacteria.

Glomalin is a unique and abundant component of soil organic matter. Glomalin, a glycoprotein produced by arbuscular mycorrhizal (AM) fungi, was discovered in the early 1990s. Glomalin appears to be a complex structure bound together by hydrophobic interactions with a consistent structure across soils. The hydrophobic component of glomalin may allow this glycoprotein to coat AM hyphae to reduce solute loss. Arbuscular mycorrhizal fungi colonize 80% of vascular plant species and are found worldwide in almost every soil. As AM fungal hyphae degrade, glomalin sloughs off onto soil particles providing a hydrophobic coating for stabilization. In temperate soils, glomalin amounts vary from 2 to 15 mg/g soil. Recent work showed that glomalin is a unique and major component of extractable organic matter. A comparison was made of components extracted by classical techniques used in humic acid (HA) research and techniques used to extract glomalin. Weights and ^{1}NMR spectra of HA and glomalin were compared in eight soils representing different geographic regions of the US. By gravimetric and carbon weight, glomalin contributed more to soil organic matter than did humic acid. ^{1}NMR spectra showed a unique structure on glomalin that is not present on humic acids. On average, glomalin comprised 27% of the total soil carbon for soils from the four geographic regions of the US. **Role:** Dr. Wright led this research in collaboration with graduate student K. Nichols. **Impact:** This information will change the way the soil organic matter is investigated and the way that management of soils will be pursued to maintain or increase stability and productivity. Glomalin levels can be monitored to determine effects of management practices on soil quality.

1265-21220–176
Biological Technologies as Alternatives to Chemicals for Control of Soilborne Pathogens

Identified genes that encode key enzymes that control root colonization by biocontrol organisms. Colonization of subterranean portions of plants by beneficial microbes is thought to be essential for disease suppression in many biocontrol interactions. Unfortunately colonization is a poorly understood process. **Role and Accomplishments:** Dr. Roberts led a team demonstrating that the genes *pfkA, rpiA, sdhA*, and *degS* are important for colonization of cucumber seeds and/or roots by the plant-beneficial bacterium *Enterobacter cloacae*. The genes *pfkA, rpiA,* and *sdhA* encode key enzymes in glycolysis, the pentose phosphate pathway, and the tricarboxylic acid cycle, respectively. This establishes these pathways and the catabolism of carbohydrates and other reduced carbon compounds as important substrates for colonization of plant surfaces. The gene *degS* functions in stress responses. In addition, Dr. Roberts led a team that developed a method that allows for the rapid determination of the spatial distribution of plant-beneficial bacteria during colonization of the rhizosphere. Prior methods were extremely labor-intensive making these studies prohibitive to perform. **Impact** is demonstrated by publications in journals, news articles in magazines including Genetic Engineering News and Business Week, two Trust Agreements with biotechnology companies, and visiting scientists interested in working on these projects.

Developed a cover crop-based system for tomato production in subtropical Florida. Since soil fumigants were introduced into vegetable production over 70 years ago, soil fumigation became a vital practice in tropical and subtropical regions of the world to protect the crops from nematodes, mainly root-knot (*Meloidogyne incognita*), and other soil pathogens. The most widely used and effective soil fumigant, methyl bromide (MeBr), has recently been banned due to the harm it causes to the ozone in the stratosphere, and its banning left no alternatives to vegetable growers in Florida. **Role and Accomplishment:** Because of his expertise in developing alternative production systems, Dr. Abdul-Baki was invited to participate with the University of Florida research team at Homestead in developing an alternative system to MeBr. After four years of research, a biologically-based alternative system was developed using the nematode-resistant cover crops sunn hemp (*Crotalaria junica* cv. Tropic Sun), cowpea (*Vigna unguiculata* cv. Iron Clay), and velvetbean (*Mucuna deeringiana*). Results of two years on tomatoes planted in nematode infested soils in south Florida show that the alternative system yielded equal to or higher than the MeBr system. **Impact:** Yield increases plus savings on MeBr and fertilizers resulted in an average net return of $1,200/ha over the MeBr production system. In addition to suppressing nematodes, the alternative system reduced soil erosion, improved soil fertility, and protected the environmentally fragile agroecosystem of the Everglades from harmful pesticides.

1265-21000-138
Enhancement of High Value Cropping Systems through Management of Cover Crops

Discovered the ability of eastern gamagrass to tolerate acid, compact soils. Mechanical impedance, low pH, aluminum toxicity, and waterlogging of soils are important limitations to successful culture of crop plants. It has been estimated that 39% of the soils in the mid-Atlantic region have root restriction layers within 50-100 cm of the surface. Species are needed that are adapted to such sites. Eastern gamagrass is a perennial, warm-season grass, native to eastern North America that can be used as a forage crop, vegetative hedges, and to ameliorate marginal soils. In collaboration with a graduate student, Rachel Gilker, and her major professor, Ray Weil, Dr. Krizek showed in a greenhouse study conducted under simulated soil stress in polyvinyl chloride (PVC) columns, that roots of eastern gamagrass were able to penetrate an aluminum toxic soil while those of sordan, a hybrid of sorghum and sudan grass, were unable to do so. In research conducted over a four-year period, he demonstrated that eastern gamagrass was able to produce relatively high levels of biomass despite adverse stress imposed by shallow top soil, low pH, high bulk density and severe deficits in soil moisture during three of the four years. **Role:** As PI on a $100,000 USDA competitive grant, Dr. Krizek conceived the project, planned the research, advised a graduate student, and led a team of researchers from AMS, ARS, BCS, NRCS, and the University of Maryland in executing the work. **Impact:** These findings demonstrate the ability of eastern gamagrass to tolerate and even flourish on an acid, aluminum-toxic, compact soil. These findings have attracted considerable interest by scientists and farmers throughout the world who are looking for warm season grasses that have high forage value, can serve as a grass hedge to reduce the loss of soil and nutrients to adjacent streams, and be used for reclamation of marginal lands. Dr. Krizek's efforts on the USDA grant in identifying key participants in research and extension, coordinating a comprehensive demonstration and research program on eastern gamagrass, and developing guidelines for the culture and management of eastern gamagrass through special training sessions for grassland specialists, technical updates, and preparation of two video tapes has renewed interest in this important warm season grass in sustainable agriculture.

Bred and released the first forage soybean cultivars developed by the Agricultural Research Service. Dr. Devine used conventional plant breeding techniques to develop three forage soybean cultivars with exceptionally tall (up to six feet) stature and lodging resistance: Donegal, Derry, and Tyrone. Donegal was released for use in the Northeast, Derry for use in the northern Midwest, and Tyrone for use in the southern U. S. **Impact:** Acreage planted to these cultivars has grown rapidly and it is estimated that they were grown on 65,000 acres in the U.S. in 2002. For this work, Dr. Devine was awarded the Beltsville Area Technology Transfer Award and an award from the Federal Laboratory Consortium for Excellence in Technology Transfer.

1265-21660-001
Long-Term Field Experiment to Evaluate Sustainability of Organic and Conventional Cropping Systems.

Developed improved methodology for measuring nutrient mineralization from manure and compost amendments. Appropriate use of organic sources of nutrients requires that we develop practical means and models of assessing N and P release rates. In addition, determining the full value of organic materials requires that we assess their impact on soil quality. This research showed that N and P release from stockpiled and composted cattle manure and amended soils mirrors carbon mineralization dynamics, and that these patterns can be modeled using log-normal distributions. Analysis of manure and compost amendments on the Farming Systems Project showed that the residual effects of low application rates of poultry litter and composted poultry litter on soil C pools and other soil quality parameters lasted at least four years. **Role:** Dr. Cavigelli directs research on the Farming Systems Project and has collaborated with Dr. Dao on nutrient mineralization at this site. **Impact:** The log-normal modeling approach provides a means of providing in 14 to 20 days the same information on carbon and nutrient release that is provided in about 200 to 400 days using the current method. This improved technique should increase the practicality of measuring nutrient availability from animal manures and soils and should help inform the development of practical recommendations for manure application. The method also was used to show that poultry manure, even applied at relatively low rates, has beneficial residual effects on soil quality and productivity that last at least four years. This method is already being used by at least one lab at the University of Illinois.

Long-term economic and environmental analyses demonstrate the potential strengths and weaknesses of sustainable cropping systems. A long-term comparison of cropping systems has been conducted on the South Farm Demonstration site since 1994. Based on results from this site and a 60-year simulation using cropping systems models, the tradeoffs between profitability, economic risks, and environmental hazards were determined. Results indicated that a cover crop-based system was the most profitable with minimal levels of erosion and herbicide losses, but high variability of profits would make this system less attractive to risk-averse farmers. Reduced-tillage organic rotations were more attractive to risk-averse farmers because of lower variability of profits as well as low erosion and absence of pesticide usage. The biggest hazard to sustainability was nutrient losses; all systems had nitrogen runoff that exceeded threshold levels in at least two-thirds of the simulation years and systems that were lowest in nitrogen runoff were highest in phosphorus losses. **Role:** Dr. Lu and former research associates conducted this analysis in collaboration with Dr. Teasdale who has directed research at the Demonstration site. **Impact:** This research demonstrated that control of nutrient losses represents a major challenge to the design of sustainable cropping systems. The results of this study will help farm operators make informed decisions and help researchers design new cropping strategies to provide an optimum balance between profitability and environmental stewardship.

1265-22000-162
Development of Biological Control Agents for Weeds

Identified genes required for tagetitoxin, a phytotoxin produced by *P. syringae* pv. *tagetis*, a potential biological control agent of Canada thistle. *Pseudomonas syringae* pv. *tagetis*, a pathogen being developed as a biological control agent of Canada thistle (*Cirsium arvense*), produces tagetitoxin, a phytotoxin that prevents the development of chloroplasts in meristematic tissue and which results in apical chlorosis or white top in infected plants. Using Tn*5* mutagenesis, two genes required for tagetitoxin production were identified. Predicted proteins of these genes have homology with the TonB system, an iron transport system, and an asparagine synthase. PCR protocols based on the DNA sequences of these genes were developed that allow *P. syringae* pv. *tagetis* to be distinguished from other *P. syringae* pathovars. **Role**: Dr. Lydon, directed the research on the isolation of genes required for tagetitoxin and wrote the related manuscript. **Impact**: This is the first report on genes related to tagetitoxin production. Using the PCR protocols developed from this work, two newly described *Pseudomonas syringae* strains capable of producing apical chlorosis were determined not to be *P. syringae* pv. *tagetis* strains. The PCR protocol may also be useful in monitoring the pathogen in target plants and in identifying vectors of the disease.

Identified the mulch properties and management practices controlling weed suppression by cover crops. Earlier research demonstrated that cover crop residues influence important micro-climatic factors that control weed seed germination and emergence from soils and that the degree of weed emergence is quantitatively related to residue biomass. Recently, a theoretical approach to modeling weed emergence through mulches was developed based on the identification of two newly-defined measures of mulches, "mulch area index" and "solid volume fraction". This "Universal Mulch Equation" successfully predicts weed emergence through a wide variety of mulch types. Research on the interaction between cover crops and other weed management practices has demonstrated that cover crops antagonize soil-based practices including preemergence herbicides and mechanical cultivation but are more compatible with foliar applied practices including postemergence herbicides or biological control. **Role:** Dr. Teasdale led this research in collaboration with Dr. C. Mohler, Cornell U. (theoretical work) and several scientists and postdocs at BARC (weed management work). **Impact:** This research established that alteration of the physical micro-environment could explain most of the weed suppressive effects caused by cover crops and challenged a popular view that allelopathic effects were predominant. This research has supported extension and grower publications developed by the sustainable agriculture community recommending systems approaches to weed and pest management aimed at reducing herbicide inputs. Dr. Teasdale has been invited to speak and consult with twenty university, regional, national, and international audiences concerning this research.

TECHNOLOGY TRANSFER ACCOMPLISHMENTS

A meaningful dialogue between growers, members of the agricultural community, and researchers is essential for relevant research on sustainable agriculture to be conducted. This involves not only transfer of technology after completion of research projects but also input at the beginning of project planning and ongoing interaction during the research process. Staff of the Sustainable Agricultural Systems Lab are committed to supporting these dialogues and have established a number of partnerships that facilitate communications among the local community. A portion of the salary of M. Davis and B. Coffman support these efforts. Examples of activities in the past two years include:

- Laboratory personnel (Davis, Coffman) collaborated with Maryland Extension, NE SARE, and Future Harvest-CASA in organizing a regional conference "Farming For Profit and Stewardship" that is conducted annually in Hagerstown, Md, to provide relevant information on marketing, production, and environmental protection to small farmers and agricultural professionals in the region.
- Conducted field days and participated in local meetings targeted to benefit under-served farmers in the mid-Atlantic states. SASL (Coffman) and local extension personnel collaborated to present new technologies that could be adapted and adopted by small farmers to develop more sustainable and profitable agricultural enterprises.
- Established a Focus Group of farmers and extension personnel to provide annual guidance to the Farming Systems Project (Cavigelli, Davis).
- SASL personnel (Teasdale, Davis, Gilbert) have participated with Maryland Extension, Accokeek Foundation, Future Harvest-CASA, PASA, and Winrock International on a Small Farms Success Project funded by an IFAFS Grant designed to facilitate sustainable marketing and production by small farmers in the mid-Atlantic area.
- Conducted field days at the Univ. FL Tropical Research and Education Center, Homestead, Univ. CA, Davis, and Cedar Meadows Farms, PA; organized three annual Soil Health Symposia at Indio, CA, to promote use of cover crops in these areas (Abdul-Baki).
- Dr. Devine released TW 98-1 soybean germplasm that displays a high frequency of twinspots on the foliage during the juvenile stage; 'Tara' a multi-use soybean cultivar for forage, grain, and wildlife; and 'Moon Cake' an edible soybean cultivar.
- A Trust Agreement was established between SASL scientists D. Roberts and J. Buyer and Hankook Bioceramics Co., LTD, Daegu, South Korea, to test promising bacterial agents for the biological control of soilborne pathogens of vegetable crops.
- Distribution of information to growers and agriculturalists in various electronic formats including 1) CD-ROM establishing comprehensive guidelines for composting methods and standards (Millner); 2) CD-ROM providing an interactive crop sequencing calculator in collaboration with the ARS Northern Great Plains Research Lab (Wright); 3) two video tapes on eastern gamagrass in support of a Fund for Rural America project involving ARS, USDA/NRCS, and Maryland Extension Service (Krizek); 4) a video on organic grain production sponsored by NE SARE (Davis); and 5) the SASL website (Matteson).

FUTURE RESEARCH DIRECTIONS

Staff of the Sustainable Agricultural Systems Lab already have made significant contributions toward developing alternative cropping systems and understanding important scientific principles underlying sustainable systems. Successful completion of current projects will add to this knowledge and will contribute to the needs of stakeholders in the sustainable community. The current strengths of this lab and plans for individual research programs are described under the heading "Contributions from Individual Scientists" at the end of this booklet. There are several new research directions that this lab could pursue that would enhance its capacity and potential. Pursuit of these directions will be minimal without additional funding for staff and equipment.

Potential new research programs:

- Organic farming has become a highly visible alternative form of crop production yet this lab has no dedicated projects or staff that can become the focal point for relevant research on these systems. There has been limited research on several local organic farms and two fields at BARC will become organically certified this spring, however, these activities have been dependent on NPS and Area surpluses for funding. There is interest from many researchers at BARC and opportunities for multi-disciplinary research including production, human nutrition, food quality, and environmental studies, but there is no funding for a core scientific staff to lead and coordinate these efforts. SASL could provide an ideal setting for housing a core leadership staff for an organic farming program.

- Agricultural systems have been recognized as a potential source or means of mitigating the effects of greenhouse gases, yet there are insufficient funds to fully address this research in our current projects. There is marginal funding to do greenhouse gas research and maintain core data collection at the Farming Systems Project site. Additional funding for staff and equipment would permit this research to be expanded to additional sites and integrate with staff from other labs that have formed an informal network for this work.

- There is public concern about the impact of introducing genetically modified organisms into the environment but no projects currently available in the lab to address this issue. Although there is a concentration of molecular biologists at BARC, there is no focus on understanding the impact or mitigation of GMO's in the agroecosystem and directing their development to enhance sustainability.

- Although we are named a "systems" lab we lack the integrating capabilities for formulating truly systems solutions to designing a sustainable agriculture. A capacity to model agroecosystems on both a temporal and a spatial scale and to integrate phenomena that describe processes at subfield to landscape levels would greatly enhance our ability to predict and validate the sustainability of farming systems.

SASL 2003 ARMPS

Note: Includes changes that have been made to plan since approval in August, 2002.

	Dollars	
Net to Area	3,743,579	
Indirect Research Cost	1,042,304	
Shared Research Cost	33,519	
Subtraction for Temporary Funds	19,230	
Net to SASL	2,648,526	
Permanent Salaries		FTE
Category 1 Research Scientists	1,173,056	9.55
Category 4 Service Scientists	195,609	1.70
Category 3 Support Scientists	408,572	6.15
Category 7 Technicians	238,524	4.50
Category 9 Administrative Support	76,608	2.00
Step Increases/Awards/etc.	20,000	
Total	2,112,369	23.90
Discretionary Funds	536,157	
Discretionary Funds per 11.25 SY	47,658	
Temporary Salaries		
Scientific (Post-Docs, etc.)	394,022	7.05
Students (GS-3/4 Support)	53,318	2.20
Total	447,340	9.25
Headquarters Research Associate Awards (3)	120,000	
Adjusted Temporary Salaries	327,340	
All-Other	208,817	
All-Other per 11.25 SY	18,562	

POSITION STAFFING PLAN

Employee Name	Position #	Position Title	Pay Plan-Grade(FPL)	Status	FTE	Foot-note	NTE date
Teasdale, John	1B8434	Sup. Plant Physiologist	GS-14(0)	PFT	1.00	L2	
Sikora, Larry	1B3340	Microbiologist	GM-15(0)	PFT	.15	D1	
Enkiri, Nancy	3B3345	Microbiologist	GS-11(11)	PFT	.15	D1	
Millner, Patricia	1B3344	Microbiologist	GM-15(0)	PFT	.60	C1	
Reynolds, Sara	3B3839	Microbiologist	GS-9(9)	PFT	1.00		
Bzdil, Michael	7B8149	Bioscience Techn.	GS-5(5)	TFT	.00	D2	
Krizek, Donald	1B3578	Plant Physiologist	GM-15(0)	PFT	1.00		
Clark, H. David	7B3540	Biol. Sci. Lab. Techn.	GS-9(9)	PFT	1.00		
Devine, Thomas	1B3619	Research Geneticist	GM-15(0)	PFT	1.00		
Mascio, Chris	0B8225	Biol. Sci. Lab. Techn.	GS-4(4)	TPT	.20	J	
Vacant	0B9704	Biol. Sci. Aid	GS-4(4)	TPT	.20	J	
Bergen, Nathan	0B9422	Biol. Sci. Aid	GS-3(3)	TPT	.20	J	
Kelly, John	0B9812	Biol. Sci. Lab. Techn.	GS-4(4)	TPT	.20	J	
Jenkins, Colm	0B405	Biol. Sci. Aid	GS-1(1)	TPT	.20	J	
Wright, Sara	1B4667	Soil Scientist	GS-15(0)	PFT	1.00		
Nichols, Kris	7B7885	Biol. Sci. Lab. Techn.	GS-9(9)	TFT	.60		5/14/03
Abdul-Baki, Aref	1B8189	Plant Physiologist	GS-15(0)	PFT	.80	C3, L1	
Carrera, Lidia	2B7849	Plant Physiologist	GS-11(11)	TFT	.75	F	7/11/03
Ewashkow, Peter	7B9170	Agr. Sci. Lab. Techn.	GS-7(9)	PFT	1.00		
Lu, Yao-chi	4B3913	Research Ag. Economist	GS-15(0)	PFT	.70	C2	
Lemberg, Beth	6B8093	Agricultural Economist	GS-13(13)	TFT	.70	C2	
Coffman, Ben	4B3913	Research Agronomist	GS-14(14)	PFT	1.00		
Lydon, John	1B4265	Plant Pathologist	GS-13(0)	PFT	1.00	L1	
Kong, Hyesuk	2B9491	Plant Pathologist	GS-11(11)	TFT	1.00	F	
Patterson, Cheryl	3B8211	Biologist	GS-11(11)	PFT	1.00		
Buyer, Jeffrey	1B4458	Research Chemist	GS-13(0)	PFT	1.00	L1	
Blackwood, C.	2B8166	Microbiologist	GS-11(11)	TFT	1.00	E1	
Tesch, Stanley	7B3351	Biol. Sci. Lab. Techn.	GS-7(9)	PFT	1.00		
Roberts, Daniel	1B837	Microbiologist	GS-13(0)	PFT	1.00	L1	
McKenna, L.	7B8192	Bio. Sci. Lab. Techn.	GS-8(9)	PFT	1.00		
Lee, David	0B8152	Bio. Sci. Lab. Techn.	GS-4(4)	TPT	.00	C5, J	
Cavigelli, Michel	1B7200	Research Soil Scientist	GS-13(0)	PFT	1.00	L1	
Green, Steven	2B116	Soil Scientist	GS-11(11)	TFT	1.00	E1	
Jawson, Linda	7B7825	Biol. Sci. Lab. Techn.	GS-9(9)	PPT	.50		
Davis, Mark	3B7630	Agronomist	GS-11(11)	PFT	1.00		
Conklin, Anne	3B7919	Soil Scientist/Agronomist	GS-9(11)	PFT	1.00		
Rasmann, Chris	0B57	Biol. Sci. Lab. Techn.	GS-4(4)	TPT	.20	J	
Ullrich, Silke	2B8103	Plant Physiologist (RA)	GS-11(11)	TFT	1.00	E1	
Radhakrishnan, J.	2B9537	Agronomist (RA)	GS-11(11)	TFT	.75	F	7/2/03
Pillai, Parthasarathy	3B3431	Chemist	GS-11(11)	PFT	1.00		
Mangum, Ruth	3B8070	Plant Physiologist	GS-11(11)	PFT	1.00		
Vacant (Melzer)	0B8013	Biol. Sci. Lab. Techn.	GS-4(4)	TPT	.20	J	
Reed, Elizabeth	0B9605	Biol. Sci. Lab. Techn.	GS-3(3)	TPT	.20	J	
Darlington, G.	0B9615	Biol. Sci. Lab. Techn.	GS-4(4)	TPT	.20	J	
Clark, Jon	0B9701	Biol. Sci. Lab. Techn.	GS-3(3)	TPT	.20	J	
Gilbert, Leslie	3B8155	Agronomist/Horticulturist	GS-9(9)	TFT	.00	C4	
Matteson, Sandra	9B3438	Support Services Assistant	GS-7(7)	PFT	1.00		
Northrup, Nina	9B3353	Office Automation Assistant	GS-5(5)	PFT	1.00		

No Non-Federal FTE.

Footnotes:

C1 Millner is officially assigned to and supervised within SASL, devoting 60% of work time, remainder of time is spent in Animal Waste Pathogen Lab (301-1265-152).

C2 Lu and Lemberg are officially assigned to and supervised within SASL, devoting 70% of work time, remainder of time is spent in Alternate Crops and Systems Lab (301-1275-151).

C3 Abdul-Baki is officially assigned to and supervised within SASL, devoting 80% of work time, remainder of time is spent in Vegetable Lab (301-1265-145).

C4 Gilbert is officially assigned to and supervised within SASL, salary is paid by IFAFS Grant with University of Maryland (308-1265-163).

C5 Lee is officially assigned to and supervised within SASL, salary is paid by a grant from Hankook Bioceramics (393-1265-161).

D1 Sikora and Enkiri devote 15% of work time to SASL, but are officially assigned and supervised within Animal Manure and By-Products Lab (301-1265-150).

D2 Bzdil devotes 50% of his time to a grant from Michigan State University (308-1265-172) associated with SASL, but is officially assigned and supervised within Animal Waste Pathogen Lab (301-1265-152).

E1 Research Associate - Headquarters Approved, Headquarters Funded.

F Research Associate - Locally Approved, Locally Funded.

J Student Temporary Employment Program (STEP).

L1 Level I SY (Lead Scientist/Project Leader).

L2 Level II SY (Research Leader).

CONTRIBUTIONS FROM INDIVIDUAL SCIENTISTS

The Sustainable Agricultural Systems Laboratory has individual expertise in several important areas that can contribute to the understanding and development of sustainable systems. This research relates to many of the general goals and strategies outlined in the ARS Strategic Plan but, particularly, will enhance the achievement of Outcome 2—A safe and secure food and fiber system, Outcome 4—An agricultural system that protects natural resources and the environment, and Outcome 5—Enhanced economic opportunity and quality of life for Americans.

SASL staff has strengths in the following areas:

- Soil Biology/Ecology. Expertise is available in microbial diversity (Buyer), mycorrhizal fungi (Millner, Wright), glomalin (Wright), rhizosphere ecology (Roberts), nutrient dynamics (Cavigelli), and weed seed bank dynamics (Teasdale). This level of expertise provides a critical mass that will facilitate interactions and development of novel hypotheses and understandings of important biological processes that control systems attributes such as soil quality, nutrient transformations, and pest and weed populations.

- Biological Pest Management. Expertise is available in use of bacteria as biological control agents for controlling soilborne diseases (Roberts) and weeds (Lydon), use of compost for incubating and delivering biocontrol agents (Millner), and use of cover crops for suppressing pests and weeds (Abdul-Baki, Teasdale). Projects will attempt to integrate system level management of cover crops and compost with development of microbial agents to design systems reliant primarily on biological processes and minimally on pesticide/herbicide inputs.

- Sustainable Cropping Systems Management. Expertise is available in cover crop management (Abdul-Baki, Teasdale), breeding legume cover crops/specialty crops (Devine), physiological responses to environmental manipulations such as high tunnels (Krizek), agroecological responses in long-term systems experiments (Cavigelli, Teasdale, Coffman), and economic analysis of systems performance (Lu). These programs can lead to development of cropping systems to support production of high-value crops on small farms at the urban-rural interface characteristic of this region. The long-term Farming Systems Project can help identify important ecological characteristics and weaknesses of alternative production systems.

- Technology Transfer (Davis, Coffman). This work facilitates exchange of information and provides important linkages to the sustainable agriculture community.

- Excellent Technical and Office Support Staff that work well together.

This range of expertise permits SASL the opportunity to address projects from a microbial to a field scale and from a fundamental process level to a practical production level. This challenges all of us to think outside the box of our own training and to stretch the limits of our imaginations. The potential result of these interactions will be synergisms among staff that will lead to the understanding of natural synergies that promote more sustainable agroecosystems.

AREF A. ABDUL-BAKI, PLANT PHYSIOLOGIST

Summary of Research

Dr. Abdul-Baki is the Lead Scientist and contributes 0.6 FTE to the Cover Crop Project (1265-21000-138) and 0.2 FTE to the Methyl Bromide Project (1265-22000-176) within SASL; he also contributes 0.2 FTE to projects in the Vegetable Laboratory. His research focuses on developing no-tillage/minimum tillage, sustainable systems for vegetable production and orchard management. The long-term objectives of this work are to maximize land use efficiency and profitability, conserve natural resources, substitute on-farm produced, renewable resources for limited non-renewable resources as inputs, and protect the environment. He will extend the successes of the past decade, developing superior alternative no-tillage production systems that have been adopted and recognized internationally. Three systems will be investigated: 1) a no-tillage cover cropping system at BARC using hairy vetch and rye to focus on low chemical input, biological release of nutrients, suppression of weeds and reduced soil erosion; 2) a reduced tillage tomato and Bell pepper production system for south Florida with primary focus on biological suppression of root-knot nematodes and reduced weeds and chemical inputs by using the nematode-resistant cover crops, sunn hemp, velvetbean, and cowpea; and 3) a no-till cover cropping system for date orchards in southeast California using 'Lana' vetch and 'Clay Iron' cowpeas for improving soil fertility, reducing soil compaction and suppressing weeds.

Publications (1999 - present)

Abdul-Baki, A. 1999. Some options in soil management: Less tillage and more cover crops and crop rotations. Proc. Emerging Soil Management Options for Oregon Vegetable Production. pp. 1-7. (Symposium proceedings).

Abdul-Baki, A., R.D. Morse, and J.R. Teasdale. 1999. Tillage and mulch effects on yield and fruit fresh mass of bell pepper (*Capsicum annuum* L.). Journal of Vegetable Crops 5:43-58.

Tipping, P.W., C.A. Holco, A. Abdul-Baki, and J.R. Aldrich. 1999. Evaluating *Edovum puttleri* and *Podisus maculiventris* for augmentative biological control of Colorado potato beetle in tomatoes. Biological Control 16:35-42.

Abdul-Baki, A. 1999. Some options in soil management: Less tillage and more cover crops and crop rotations. Emerging Soil Management Options for Oregon Vegetable Production. Workshop Proceedings. p. 1-7. Salem, Oregon. (Proceedings)

Lu, Y.C., K.B. Watkins, J.R. Teasdale, and A. Abdul-Baki. 2000. Cover crops in sustainable food production. Food Reviews International 16:121-157.

Kotlinski, S. and A. Abdul-Baki. 2000. Rosliny okrywowe w uprawie pomidora a porazenie lisci przez ziemniaka Phytophthora infestans. Progress in Plant Protection. 40:895-898.

Kotlinski, S., J. Szwejda, U. Smolinska, and A. Abdul-Baki. 2000. Wplyw roslin okrywowych na sklad mikrobiologiczny gleby i stopien porazenia kalafiora przez smietke kapusciana Hylemya brassicae bche. Progress in Plant Protection 40:899-902.

Abdul-Baki, A., H.H. Bryan, G. Zinati, W. Klassen, M. Codallo, and N. Heckert. 2001. Biomass yield and flower production in sunn hemp: Effect of cutting the main stem. Journal of Vegetable Crop Production 7:83-104.

Bryan, H.H., A. Abdul-Baki, J.B. Reeves, III , L.M. Carrera, W. Klassen, G. Zanati, and M. Codallo. 2001. Perennial arachis spp. as a multipurpose living mulch, ground cover and forage. Journal of Vegetable Crop Production 7: 113-136.

Rice, P.J., L.L. McConnell, L.P. Heighton, A.M. Sadeghi, A.R. Isensse, J.R. Teasdale, A. Abdul-Baki, J.A. Harman-Fetcho, and C.J. Hapeman. 2001. Runoff loss of pesticides and soil: A comparison between vegetative mulch and plastic mulch in vegetable production systems. J. Environ. Qual. 30:1808-1821.

Abdul-Baki, A., J.R. Teasdale, R.W. Goth, and K.G. Haynes. 2002. Marketable yields of fresh market tomatoes grown in plastic and hairy vetch mulches. HortScience 37:878-881.

Abdul-Baki, A., C. Wilson, L.M. Carrera, S. Aslan, S. Cobb, T.Burke, and E. Brown, Jr. 2002. Browning and dieback of distal parts of fruit-bearing strands in date palms. HortScience 37:882-884.

Rice, P.J., L.L. McConnell, L.P. Heighton, A.M. Sadeghi, A.R. Isensse, J.R. Teasdale, A. Abdul-Baki, J.A.Harman-Fetcho, and C.J. Hapeman. 2002. Comparison of copper levels in run off from fresh-market vegetable production using polyethylene mulch or vegetable mulch. Environ. Toxicol. Chem. 21:24-30.

Abdul-Baki, A., S. Aslan, R. Linderman, S. Cobb, and A. Davis. 2002. Soil, Water and Nutritional Management of Date Orchards in the Coachella Valley and BARD. California Date Commission, Coachella Valley Resource Conservation District. (Bulletin)

Mills, D.J., C.B. Coffman, J.R. Teasdale, K.L. Everts, A. Abdul-Baki, J. Lydon, and J.D. Anderson. 2002. Foliar disease in fresh-market tomato grown in differing bed strategies and fungicide spray programs. Plant Disease 86:955-959.

Abdul-Baki, A., S. Aslan, L.M. Carrera, and R. Linderman. 2002. Management Practices for Early Harvest of Table Grape Vineyards in the Coachella Valley. Coachella Valley Resource Conservation District. 32 p. (Bulletin)

Mattoo, A., T. Cassol, R. Mahta, N. Ali, A. Abdul-Baki, and A. Handa. 2002. Genetic engineering of tomato fruit for sustained accumulation of polyamines during ripening to study their physiological role(s). Acta Horticulturae 575:157-161.

Abdul-Baki, A., S. Kotlinski, and T. Kotlinska. 2002. Vegetable production systems. Vegetable Crops Research Bulletin No. 57. Research Institute of Vegetable Crops. Skierniewice, Poland. Vol. 57: 11-21. (Bulletin)

Abdul-Baki, A., H.H. Bryan, W. Klassen, and M Codallo. Propagation and establishment of perennial peanuts for ground covers along roadsides. Proceedings of Florida State Horticultural Society. In press.

Wang, Q.W., W. Klassen, Z. Handoo, A. Abdul-Baki, B. Bryan, and Y. Lu. Influence of cover crops on soil nematodes in a south Florida tomato field. Soil and Crop Science Society of Florida Proceedings. In press. (Proceedings)

Cooperator	**Affiliation**
Aslan, Sam	Natural Resources Conservation Division, USDA-ARS, Indio, CA
Bryan, Herbert	University of Florida, Homestead
Burke, Tim	Manager of Oasis Date Gardens, Thermal, CA
Chitwood, David	Nematology Lab, USDA-ARS
Haynes, Kathleen	Vegetable Lab, USDA-ARS
Klassen, Waldemar	University of Florida, Homestead
Li, Yoncong	University of Florida, Homestead
Mattoo, Autar	Vegetable Lab, USDA-ARS
Mitchell, Jeffrey	Department of Horticulture, University of California, Davis
Morse, Ronald	Virginia Polytech Institute, Blacksburg, VA
Wilson, Clyde	U.S. Salinity Lab, USDA-ARS, Riverside, CA

JEFFREY S. BUYER, RESEARCH CHEMIST

Summary of Research

Dr. Buyer is the Lead Scientist and contributes 1.0 FTE to the Soil Microbiology Project (1265-12000-025). Three main objectives are to: (1) develop improved methods to characterize soil microbial communities, (2) analyze the factors controlling soil microbial community structure and function, and (3) develop strategies to improve colonization of root and seed by beneficial microorganisms. We are currently working on improving methodology for the identification of bacteria by analysis of fatty acid methyl esters. We are also developing a method for analysis of soil DNA by T-RFLP using paramagnetic beads which we believe will be faster and cheaper than current T-RFLP methods. Interactions between soil, root, seed, and microbial communities are being studied in growth chamber experiments, using fatty acid analysis, substrate utilization assays, and analysis of soil DNA. The effects of conventional and sustainable agricultural management systems on soil microbial communities are being studied in Maryland. Field studies in arid rangelands are being conducted to determine the effects of grazing intensity on soil microbial communities. We are researching the non-target effects of genetically engineered Bt corn on soil and rhizosphere microbial communities in growth chamber and field experiments. The role of small molecules such as carbohydrates, amino acids, and organic acids in colonization, growth, and metabolism of beneficial microorganisms is being studied by analysis of seed and root exudates using gas chromatography and mass spectroscopy.

Publications (1999-present)

Buyer, J.S., D.P. Roberts, and E. Russek-Cohen. 1999. Microbial community structure and function in the spermosphere as affected by soil and seed type. Can. J. Microbiol. 45:138-144.

Roberts, D.P., P.D. Dery, I. Yucel, J.S. Buyer, M.A. Holtman, and D.Y. Kobayashi. 1999. Role of pfkA and general carbohydrate catabolism in seed colonization by Enterobacter Cloacae. Appl. Environ. Microbiol. 65:2513-2519.

Roberts, D.P., E.L. Stromberg, G.H. Lacy, and J.S. Buyer. 1999. Biological Disease Control: Considerations for Seed Treatment and Stand Establishment. Acta Horticulturae 504:69-74.

Stromberg, E.L., D.P. Roberts, G.H. Lacy, P.D. Dery, and J.S. Buyer. 1999. Field evaluation of selected bacterial isolates and seed treatment fungicides for the control of take-all in Jackson soft red winter wheat, 1998. Bio. Cult. Tests Control Plant Dis. 14:127-129.

Moline, H., J.E. Hubbard, J.S. Karns, J.S. Buyer, and J.D. Cohen. 1999. Selective isolation of bacterial antagonists of Botrytis cinerea. Eur. J. Plant Path. 105:95-101.

Roberts, D.P., P.D. Dery, I. Yucel, and J.S. Buyer. 2000. Importance of pfkA for rapid growth of Enterobacter cloacae during colonization of crop seeds. Appl. Environ. Microbiol. 66:87-91.

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Li, W., D.P. Roberts, P.D. Dery, N.M. Mock, C.J. Baker, and J.S. Buyer. 2000. Effect of decreased catabolic capability of Enterobacter cloacae strain A-11 on root colonization and suppression of damping-off caused by Pythium ultimum on cucumber. Proceedings of the 5th International PGPR Workshop, Cordoba, Argentina. http://www.ag.auburn.edu/argentina. (Symposium Paper)

Gagliardi, J.V., J.S. Buyer, J.S. Angle, and E. Russek-Cohen. 2001. Structural and functional analysis of whole-soil microbial communities for risk and efficacy testing following microbial inoculation of wheat roots in diverse soils. Soil Biol. Biochem. 33:25-40.

Stromberg, E.L., D.P. Roberts, G.H. Lacy, P.D. Dery, and J.S. Buyer. 2001. Field evaluation of selected bacterial isolates and seed treatment fungicides for the control of Take-all in Madison Soft Red Winter Wheat, 2000. Bio. Cult. Tests Control Plant Dis. Report 2001:S25.

Buyer, J.S., D.P. Roberts, P. Millner, and E. Russek-Cohen. 2001. Analysis of fungal communities by sole carbon source utilization profiles. J. Microbiol. Methods 45:53-60.

Royt, P.W., R.V. Honeychuck, V. Ravich, P. Ponnaluri, L.K. Pannell, J.S. Buyer, V. Chandhoke, W. Stalick, L.C. de Sesso, and R. Ghei. 2001. Pseudan: A novel iron chelator isolated from the cytoplasmic membrane of Pseudomonas aeruginosa. Bioorganic Chemistry 29:387-397

Mummey, D.L., P.D. Stahl, and J.S. Buyer. 2002. Soil microbiological and physicochemical properties 20 years after surface mine reclamation. Soil Biol. Biochem. 34:1717-1725

Mummey, D.L., P.D. Stahl, and J.S. Buyer. 2002. Microbial biomarkers as an indicator of ecosystem recovery following surface mine reclamation. Applied Soil Ecology 21:251-259

Buyer, J.S. 2002. Rapid sample processing and fast chromatography for identification of bacteria by fatty acid analysis. J. Microbiol. Methods 51:209-215

Buyer, J.S., D.P. Roberts, and E. Russek-Cohen. 2002. The rhizosphere effect and microbial community structure. Can. J. Microbiol. 48:955-964.

Stromberg, E.L., D.P. Roberts, G.H. Lacy, S.M. Lohrke, W. Li, and J.S. Buyer. 2002. Field evaluation of selected bacterial isolates and seed treatment fungicides for the control of take-all in Roanoke soft red winter wheat in Virginia, 2001. Biol. Cult. Tests Control Plant Dis. 17:S08.

Buyer, J.S. 2002. Identification of bacteria from single colonies by fatty acid analysis. J. Microbiol. Methods 48:259-265.

Buyer, J.S. 2003. Improved fast gas chromatography for FAME analysis of bacteria. J. Microbiol. Methods. In press.

Cooperator	**Affiliation**
Belnap, J.	USGS
DeLuca, T.	University of Montana
Denison, R. F.	University of California, Davis
Dively, G.	University of Maryland
Russek-Cohen, E.	University of Maryland
Stahl, P.	University of Wyoming

MICHEL A. CAVIGELLI, SOIL SCIENTIST

Summary of research

Dr. Cavigelli is the Lead Scientist and devotes 1.0 FTE to the Farming Systems Project (1265-21660-001). The major focus of this long-term field cropping systems study is to evaluate the sustainability of no-till, conventional till, and organic cropping systems by measuring agronomic performance, nutrient dynamics, soil biological activity and community structure, and predicting the long-term sustainability of cropping systems. Dr. Cavigelli's research contributes to all areas of FSP research but his primary focus is on agronomic performance and C, N and P dynamics. He is directly responsible for base-line data such as crop and weed biomass, crop nutrient contents, soil fertility, soil quality, soil nutrient dynamics, and soil moisture and temperature. Nutrient dynamics research currently includes measuring soil inorganic nitrogen dynamics, biogenic greenhouse gas (CO2, N2O, CH4) fluxes, soil and nutrient runoff potentials, and nitrate leaching potential. His goal is to better understand the factors controlling these dynamics and to incorporate these measurements into existing predictive models to help assess C, N and P budgets for the FSP cropping systems. Dr. Cavigelli is also analyzing three years of data on the spatial and temporal variability of soil and crop properties measured on the FSP site prior to the establishment of plots in 1996. In addition, Dr. Cavigelli conducts research on an organic farm near Buckeystown, MD, to determine the effects of intensive tillage on soil quality and the appropriate greensand application rate to maintain adequate K for alfalfa production.

Publications (1999-present)

Cavigelli, M.A. and G.P. Robertson. 2000. The functional significance of denitrifier community composition in a terrestrial ecosystem. Ecology 81:1402-1414.

Cavigelli, M.A., S.R. Deming, L.K. Probyn, and D.R. Mutch (eds.). 2000. Michigan field crop pest ecology and management. MSU Extension Bulletin E-2704, 100 pp. (Peer-reviewed Extension bulletin).

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Cavigelli, M.A. and S.J. Thien. 2003. Phosphorus bioavailability following incorporation of green manure crops. Soil Science Society of America Journal. In press.

Dao, T.H. and M.A. Cavigelli. 2003. Mineralizable carbon, nitrogen, and water-extractable phosphorus release from stockpiled and composted manure and amended soils. Agronomy Journal. In press.

Cooperator	**Affiliation**
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Groffman, Peter	Institute of Ecosystem Studies
Handoo, Zafar	USDA-ARS, NL
Hunt, Ray	USDA-ARS, HRSL
Lengnick, Laura	Warren Wilson College
Liang, Shunlin	U. of MD
McCarty, Greg	USDA-ARS, EQL
Meisinger, Jack	USDA-ARS, AMBL
Pachepsky, Yakov	USDA-ARS, AMBL
Szlavecz, Katalin	Johns Hopkins U
Thien, Steve	Kansas State U
Tsegaye, Tseferi	U. of AL
Wander, Michelle	U. of IL
Weil, Ray	U. of MD
GRACEnet participants	
Soil Quality Assessment Framework participants	

C. BENJAMIN COFFMAN, RESEARCH AGRONOMIST

Summary of Research

Dr. Coffman conducts research for three projects: 0.5 FTE on the Weed Biocontrol Project (1265-22000-062), 0.25 FTE on the Farming System Project (1265-21660-001), and 0.25 FTE on the Cover Crops Project (1265-21000-138). Contributes to experimental planning, field operations, and weed management in these projects. Provides weed characterization and weed management, agronomic inputs, field operations management, data collection, and technology transfer for the South Farm Sustainable Agriculture Demonstration and the Farming Systems Project. Contributes to weed management investigations on an organic farm in Frederick County, MD. Serves on the planning committee for the organic research project to be established at BARC. Cooperates with and facilitates research projects conducted by research associates. This included a long-term, fresh-market tomato disease investigation that led to several peer-reviewed publications. This currently includes investigations by Dr. J. Radhakrishnan of vinegar for its usefulness as an herbicide for organic agriculture. Developed a cooperative outreach effort for minority and under-served farmers in the mid-Atlantic area that included a Small Farmer Field Day at BARC and a small farmer workshop at Salisbury, MD. Began a technology transfer/outreach effort with Virginia State University to address the needs of minority tobacco and peanut farmers in southern Virginia and North Carolina as they transition from historical cropping systems into new production systems. This will involve a workshop in Petersburg in 2003, and is expected to eventually include cooperative research in crop production systems, marketing, economics, and rural sociology.

Publications (1999 to present)

Hong, J.H., D.J. Mills, C.B. Coffman, J.D. Anderson, M.J. Camp, and K.C. Gross. 2000. Tomato cultivation systems affect subsequent quality of fresh-cut fruit slices. J. Am. Soc. Hort. Sci. 125:729-735.

Teasdale, J.R., R.C. Rosecrance, C.B. Coffman, J.L. Starr, I.C. Paltineanu, Y.C. Lu, and B.K. Watkins. 2000. Performance of reduced-tillage cropping systems for sustainable grain production in Maryland. Am. J. Altern. Agri. 15:79-87.

Shunxiang, W., Y.C. Lu, D.J. Mills, C.B. Coffman, and J.R Teasdale. 2002. Economic evaluation of alternative production systems for fresh-market tomatoes in the mid-Atlantic region. Journal of Vegetable Crop Production 8:91-107.

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Mills, D.J., C.B. Coffman, J.R. Teasdale, K.L. Everts, A.A. Abdul-Baki, J. Lydon, and J.D Anderson. 2002. Foliar disease in fresh market tomato grown in differing bed strategies and fungicide spray programs. Plant Disease 86:955-959.

Cooperator	Affiliation
Butler,Bryan	University of Maryland, Cooperative Extension
Everts, K. L.	University of Maryland/University of Delaware Cooperative Extension
Fitzgerald, Caragh	University of Maryland, Cooperative Extension
Hankins, Andy	Virginia State University, Cooperative Extension
Hapeman, C. J.	Environmental Chemistry Laboratory, USDA-ARS
Sommerville, Cliff	Virginia State University, Cooperative Extension
Vough, Lester	University of Maryland, Dept. Landscape and Natural Resources

THOMAS E. DEVINE, RESEARCH GENETICIST

Summary of Research

Dr. Devine contributes 100% to the Cover Crop Project (1265-21000-138). A selection program is underway with the goal of developing hairy vetch cultivars with improved winter hardiness and earlier maturity without the hard seed trait. After evaluating 451 subteranean clover lines at 2 locations in Maryland, lines with the most vigorous growth and winter hardiness will be evaluated by northeastern cooperators. Soybean cultivars will be developed using forage germplasm already developed for tall growth habit and lodging resistance. Successful recent releases from this program include Moon Cake and Tara. Moon Cake, a large-seeded vegetable soybean cultivar of exceptionally tall height and good lodging resistance, intended for use as edamame (large-seeded vegetable soybean), was released in 2003. Under good growing conditions, plants of Moon Cake grow to 6 feet with 21 seed bearing nodes. Moon Cake is expected to prove especially valuable to organic vegetable soybean producers since its tall growth should enable it to compete well against late summer weeds. Plants of Moon Cake may serve a dual use in small scale diversified farming operations. Following harvest of pods from the plants, leaves and stems may provide a high protein forage for livestock such as goats, sheep, etc. Tara, a tall growing, large biomass, multi-use soybean cultivar, was released in December 2002 for use in wildlife seed mixtures and as a grain and forage soybean. Because of its tall growth and smaller seed size, Tara is well suited to use in wildlife seed mixtures by providing tall cover and a high protein forage for wildlife. Tara also provides high quality forage for livestock and dairy producers. Growers of Tara retain the option of using the crop as either forage or grain until late in the growing season. The increased crop residue biomass produced by Tara provides soybean grain producers with a soil conservation benefit by reducing soil erosion and increasing carbon sequestration. The genetic linkage of the soybean genes lf2 controlling seven-foliate leaves and Pd2 controlling dense pubescence, was established.

Publications (1999 to present)

Kuykendall, L.D., F.M. Hashem, G.R Bauchan, T.E. Devine, and R.B. Dadson. 1999. Symbiotic Competence of Sinorhizobium fredii on Twenty Alfalfa Cultivars of Diverse Dormancy. Symbiosis: 1-16.

Redfearn, D.D., D.R. Buxton, and T.E. Devine. 1999. Sorghum Intercropping Effects on Yield, Morphology, and Quality of Forage Soybean. Crop Science 39: 1380-1384.

Ude, G.N., T.E. Devine, L.D. Kuykendall, B.F. Matthews, J.A. Saunders, W. Kenworthy, and J.J. Lin. 1999. Molecular Mapping of the Soybean Nodulation Gene, Rj4. Symbiosis 26: 101-110.

Devine, T.E., R.F. Lucey, E.O. Hatley, D.E. Starner, and J.H. Cherney. 1999. Performance of forage soybeans in the mid and north Atlantic States. Proceedings World Soybean Research Conference VI. Chicago, Illinois. (Proceedings)

Brown, H.J., J.M. Koivisto, G.P.F. Lane, R.H. Phipps, and. T.E. Devine. 2001. First year evaluation of forage soybeans (Glycine max (L.) Merr.) in theUnited Kingdom. p. 290-293. In: T. Terrill (ed.) Proc. Am. Forage and Grassl. Council, April 21-25, 2001, Springdale, AR. AFGC, Georgetown, TX. (Proceedings)

Matthews, B.F., T.E. Devine, J.M. Weisemann, H.S. Beard, K.S. Lewers, M.H. MacDonald, Y.B. Park, R. Maiti, J.J. Lin, J. Kuo, M.J. Pedroni, P.B. Cregan, and J.A. Saunders. 2001. Incorporation of Sequenced cDNA and Genomic Markers into the Soybean Genetic Map. Crop Science 41: 516-521.

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Nayigihugu, V., D.W. Kellogg, D.E. Longer, Z.B. Johnson, K.A. Anschutz, and T.E. Devine. 2002. Performance and Ensiling Characteristics of Tall-Growing Soybean Lines Used for Silage. The Professional Animal Scientist 18: 85-89.

Cooperator	**Affiliation**
Bransby, David	Auburn University
Cherney, Jerome	Cornell University
Curran, Bill	Penn State University
Dadson, Robert	University of Md. Eastern Shore
Dao, Tranh	Animal Manure Byproduct Laboratory, USDA-ARS
Davis, Greg	Seedway
Kephart, Ken	Montana State University
McMurtrey, J.E.	Remote Sensing Laboratory, USDA-ARS
Mebrahtu, Tedesse	Virginia State University
Meyer, Dwain	North Dakota State University
Neilson, David	ARS, Akron, CO
Tabor, Howard	Southern States Cooperative
Wahleithner, Jerry	Wolf River Valley Seed Company

DONALD T. KRIZEK, PLANT PHYSIOLOGIST

Summary of Research

Dr. Krizek contributes 100% to the Cover Crop Project (1265-21000-138). The overall objective of future research will be to integrate cover crops with season-extending low-cost, high tunnels to optimize market and profit potential of high-value crop production, to advance earliness of spring production, and to extend the growing season for fall production. Specific objectives will be to evaluate plastic mulches and different tunnel covering materials with respect to color, spectral transmission, reflective properties, thermal characteristics, and other factors that may alter shoot and root growth, pigment development of fruits and other edible parts, and enhance maturity and nutrient composition Other objectives will be to identify factors influencing optimum utilization of composts and cover crops in high tunnel cropping systems, determine interactions of biotic and abiotic stresses (which are expected to be encountered in high tunnels), evaluate different plastic materials to better manage beneficial insects that prey on agricultural pests in these structures, evaluate the use of selective UV filters to suppress the incidence of fungal diseases (e.g., *Alternaria* blight, *Botrytis* blight, powdery mildew, and downy mildew); and evaluate the economics of production in high tunnels. Replicated experiments using short, rapid-growing cover crops will be conducted in high tunnels to determine optimum growth conditions and season extension for speciality tomatoes and bell peppers. Cover crops, such as annual medics, brassicas, and crimson clover will be compared to hairy vetch for suitability in high tunnels. Guidelines for water and nutrient management will be developed for optimizing plant growth and mineralization rates of residues. Crop responses to mature composts will be determined with focus on application rates, nutrient turnover, retention, and persistence. Optical properties of plastic covers, temperature, relative humidity, and pest prevalence will be monitored.

List of Publications (1999 to present)

Foy, C.D., A.M. Sadeghi, J.C. Ritchie, D.T. Krizek, J.R. Davis, and W.D. Kemper. 1999. Aluminum toxicity and high bulk density: role in limiting shoot and root growth of selected aluminum indicator plants and eastern gamagrass in an acid soil. J. Plant Nutr. 22:1551-1556.

Krizek, D.T., M.J. Camp, S.R. Maxon, G.C. Meyer, J.C. Ritchie, K.M. Davis, and M.L. McCloud. 2000. Comparative germination of 1998 and 1999 lots of Germtec II ™ treated eastern gamagrass seed after 28 days in the greenhouse and laboratory. p. 182-193. In: J. C. Ritchie, J.A. Dickerson, and C.A. Ritchie (eds.), Proc. Second Eastern Native Grass Symposium. (Symposium Proceedings)

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Rhoden, E.G., J.B. Reeves III, D.T. Krizek, J.C. Ritchie, and C.D. Foy. 2000. Influence of root removal on shoot regrowth and forage quality of greenhouse-grown eastern gamagrass. p. 276-282. In: J.C. Ritchie, J.A. Dickerson, and C.A. Ritchie (eds.), Proc. Second Eastern Native Grass Symposium. (Symposium Proceedings)

Ritchie, J.C., W.D. Kemper, J.M. Englert, and D.T. Krizek. 2000. Grass hedges for erosion control. p. 283-289. In: J.C. Ritchie, J.A. Dickerson, and C.A. Ritchie (eds.), Proc. Second Eastern Native Grass Symposium. (Symposium Proceedings)

Tibbitts, T.W., J.C. Sager, and D.T Krizek. 2000. Guidelines for measuring and reporting environmental parameters in growth chambers. Biotronics 45:1-9. (Invited Review)

Erkan, M., C.Y. Wang, and D.T. Krizek. 2001. UV-C irradiation reduces microbial populations and deterioration in *Cucurbita pepo* fruit tissue. Env. Expt. Bot. 45:1-9.

Gonzalez-Aguilar, G.A., C.Y. Wang, J.G. Buta, and D.T. Krizek. 2001. Use of UV-C irradiation to prevent decay and maintain postharvest quality of ripe 'Tommy Atkins' mangoes. Intl. J. Food Sci. Tech. 36:1-7.

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Norman, H.A., D.T. Krizek, and R.M. Mirecki. 2001. Changes in membrane lipid and free fatty acid composition during low temperature preconditioning against SO_2 injury in coleus. Phytochemistry 58:263-268.

Krizek, D.T., P.H. Terry, A. Upadhyaya, C.R. Caldwell, and R.M. Mirecki. 2001. Changes in abscisic acid, stomatal conductance, and antioxidants during low temperature preconditioning against SO_2 injury in contrasting cultivars of coleus. Biotronics 30:1-14.

Gilker, R.E., R.R. Weil, D.T. Krizek, and B. Momen,. 2002. Eastern gamagrass root penetration in adverse subsoil conditions. Soil Sci. Soc. Am. J. 66:931-938.

Krizek, D.T., J.C. Ritchie, A.M. Sadeghi, C.D. Foy, E.G. Rhoden, J.R. Davis, and M.J. Camp. 2003. A four-year study of biomass production of eastern gamagrass grown on an acid compact soil. Commun. Soil Sci. Plant Anal. 34:457-480.

Krizek, D.T., D.C. Gitz III, J.C. Ritchie, and V.R Reddy. 2003. Biomass accumulation and partitioning of eastern gamagrass grown under different temperature and CO_2 levels. Acta Hort. (In press)

Cooperator	Affiliation
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YAO-CHI LU, RESEARCH ECONOMIST

Summary of Research

Dr. Lu contributes 0.70 FTE to the Farming Systems Project (1265-21660-001) in SASL and 0.30 FTE to the Alternate Crops & Systems Lab. He is conducting economic analyses of new technologies to (1) determine economic feasibility, (2) assess economic risks for adopting the new technology, (3) assess the long-term impact of the new technologies on profitability and environment quality, and (4) evaluate the trade-offs among profitability, economic risks, and environmental factors. One approach involves ex post analysis, i.e. conducting economic analysis after field experiments have been completed. In this case, we analyze costs and benefits of adopting the new technology to determine economic feasibility and evaluate the economic risks associated with adopting the new technology. Another approach is ex ante analysis, the evaluation of a new technologies' potential economic feasibility before the experiment is completed. Using this analysis, we can project expected outcomes of adopting the technology and provide agricultural scientists with an immediate determination of economic feasibility which my be used to guide future research. For example, we have conducted economic analysis of the Sustainable Agricultural Demonstration site after four years of experimentation and found that a system based on a crownvetch living mulch was not profitable. Subsequently, that system was excluded from further economic analyses and alternative systems were considered. The potential profitability and environmental impacts of the new systems were analyzed using simulation modeling.

Publications (1999 to present)

Lu, Y.-C, B. Watkins, and J.R. Teasdale. 1999. Economic analysis of sustainable agricultural cropping systems. Journal of Sustainable Agriculture 15:77-93.

Watkins, B., Y.-C. Lu, Y. Chen, and F. Gwozdz. 1999. Economic value and cost of automated on-line inspection for the U.S. broiler industry. Food Control 10:69-80.

Huang, W., Y.-C. Lu, and N.D. Uri. 1999. An evaluation of soil nitrogen testing considering the carry-over effect. Journal of Sustainable Agriculture 13(3): 5-34.

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Watkins, B., Y.-C. Lu, and Y. Chen. 2000. Economic feasibility analysis of automated on-line poultry inspection technologies. Poultry Science 79:265-274.

Lu, Y.-C., B. Watkins, J.R. Teasdale, and A.A. Abdul-Baki. 2000. Cover crops in sustainable food production. Food Reviews International 16:121-157.

Teasdale, J.R., R.C. Rosecrance, C.B. Coffman, J.L. Starr, I.C. Paltineanu. Y.-C. Lu, and B.K. Watkins. 2000. Performance of reduced-tillage cropping systems for sustainable grain production in Maryland. American Journal of Alternative Agriculture 15:79-87.

Lu, Y.-C., B. Watkins, and J.R. Teasdale. 2000. Economic and environmental comparison of an organic farming system with alternative no-tillage systems. Proceedings of the 13th International IFOAM Scientific Conference. (Proceedings)

Wu, S., D. Walker, S. Devadoss, and Y.-C. Lu. 2001. Productivity growth and its components in Chinese Agriculture after reforms. Review of Development Economics 5:375-391.

Lu, Y.-C. and V.R. Reddy. 2001. Economic analysis of pix application strategies using a cotton simulation model. 2001 Beltwide Cotton Conferences. CD Rom (Proceedings).

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Watkins, B., Y.-C. Lu, and W. Huang. 2002. A case study of economic and environmental impacts of variable rate nitrogen and water application. International Agricultural Engineering Journal 11:173-185.

Watkins, B., Y.-C. Lu, and J.R. Teasdale. 2002. Long-term economic and environmental assessment of alternative cropping systems for the Mid-Atlantic region. Journal of Sustainable Agriculture 20:61-82.

Lu, Y.-C., and V.R. Reddy. 2002. Economic analysis of pix (mepiquat chloride) application strategies. Agricultural Engineering Journal 11:133-143.

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Lu, Y.-C., J.R. Teasdale, and W.Y Huang. 2002. An economic and environmental tradeoff analysis of sustainable agricultural cropping systems. Journal of Sustainable Agriculture. In press.

Camp, C.R., Y.-C. Lu, and E.J. Sadler. 2002. Spatial variation in crop yield: II. Implications for water and nitrogen management. 2002 Irrigation Association Technical Conference. Irrigation Association. CD Rom (Proceedings).

Wang, Q.W., W. Klassen, Z. Handoo, A. Abdul-Baki., B. Bryan, and Y. Lu. Influence of cover crops on soil nematodes in a south Florida tomato field. Soil and Crop Science Society of Florida Proceedings. In press. (Proceedings)

Wu, S., Y.-C. Lu, J.E. McMurtry, G. Weesies, T.E. Devine, and G.R. Foster. The economic and

environmental benefits of large-biomas soybeans (LBSs) for increasing residues. Journal of Sustainable Agriculture. In press.

Lu, Y.-C., E.J. Sadler, and C.R. Camp. Optimal levels of irrigation in corn production in the Southeast Costal Plain. Journal of Sustainable Agriculture. In press.

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Bryan, Herbert	University of Florida, Homestead
Camp, Carl R.	USDA, ARS, Florence, SC.
Huang, Wen-yuen	USDA, Economic Research Service, Washington, DC.
Klassen, Waldemar	University of Florida, Homestead
Sadler, E. John	USDA, ARS, Florence, SC.

JOHN LYDON, PLANT PHYSIOLOGIST

Summary of Research

Dr. Lydon is the Lead Scientist and contributes 100% to the Weed Biocontrol Project (1265-22000-162). Research goals are:

1) Enhance the efficacy and reduce the specificity of developed or potential microbial herbicides using recombinant DNA techniques. The biological activity of microbial herbicides are enhanced by genetically modifying biocontrol microorganisms with genes from bacteria required for phytotoxin production. Genes are introduced using recombinant DNA technologies. Transformed organisms are evaluated for phytotoxin production and resistance using screening procedures, bacterial bioassays, chromatographic techniques, spectrophotometric techniques, and enzymological and molecular methods. Selected transformants are compared with wild-type organisms for control of target weeds, related weed species, and their effect on crop plants. Markers for monitoring the dispersal of microbial weed biological control agents are developed using molecular genetic methodologies based on genes specific for the weed pathogens.

2) Determine the herbicidal potential of microbial, and to a lesser extent, plant metabolites. Investigate the physiological processes affected by those metabolites determined to be phytotoxic, establish site of action at the molecular level, and determine the molecular genetics of phytotoxin production. Natural products tested are extracted from producing organisms. Efficacy of natural phytotoxins is determined using bioassays and whole plant tests. Mode of action is determined using chromatographic techniques, spectrophotometric techniques, and enzymological methods. The genes required for the production of microbial phytotoxins are identified and isolated using Tn*5* mutagenesis and related molecular biological techniques. To broaden the scope of this research, collaborations have been established with Dr. Robin Mitchell, Chemist and discoverer of the phytotoxins phaseolotoxin and tagetitoxin, Hort Research, Mt Albert Research Centre, Auckland, New Zealand and Dr. Ding Jin, Molecular Biologist and expert on RNA polymerase, Laboratory of Molecular Biology, NIC, NIH, Bethesda, Maryland.

3) Determine the potential of *Aceria anthocoptes* as a biological control agent of Canada thistle (*Cirsium arevnese*) and its role as a vector of plant diseases that impact Canada thistle. The host range of *A. anthocoptes* is determined by surveying existing populations of *Cirsium* species and by conducting host range tests with a range of *Cirsium* species under greenhouse conditions. Molecular genetic methodologies are developed to compliment morphological profiles of *A. anthocoptes* to increase the accuracy of the identification of the mite with respect to other eriophyid mites that may be harbored by *Cirsium* species.

Publications (1999 to present)

Ochoa, R., E. Erbe, W.P. Wergin, C. Frye, and J. Lydon. 1999. The presence of *Aceria anthocoptes* (NALEPA) (ACARI: ERIOPHYIDAE) on *Cirsium* species in the United States. International Journal of Acarology 27:179-187.

Lydon, J. and S.O. Duke. 1999. Inhibitors of glutamine synthetase. In - Plant Amino Acids, ed. Singh, B., Marcel Dekker, Inc., New York, pp. 445-463. (Invited book chapter)

Lydon, J. and C.D. Patterson. 2001. Detection of tabtoxin-producing strains of *Pseudomonas syringae* by PCR. Letters in Applied Microbiology 32:166-170.

Baker, C.J., N.R. O'Neill, K. Deahl, and J. Lydon. 2002. Continuous production of extracellular antioxidants in suspension cells attenuates the oxidative burst detected in plant microbe interactions. Plant Physiology and Biochemistry 40:641-644.

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Bewick, T. and J. Lydon. Biological Control of Weeds - It's a Natrual. 2002. Weed Science Society of America, Biological Control of Weeds Committee, 8 pp. (Brochure).

Duke, S.O., B.E. Scheffler., D. Boyette, J. Lydon, and A. Oliva. 2003. Biotechnology for the control of weeds. In press. (Invited book chapter)

Cooperator	**Affiliation**
Bender, Carol	Oklahoma State University
Daughtry, Craig	USDA-ARS, Hydrology & Remote Sensing Laboratory
Frye, Chris	MD Dept. of Natural Resources, Annapolis, MD
Gulya, Tom	USDA-ARS, Sunflower Research Laboratory, Fargo, ND
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Mitchell, Robin	Mt Albert Research Centre, Auckland, New Zealand
Ochoa, Ron	USDA-ARS, Systematic Entomology Laboratory
Robinson, J. Michael	USDA-ARS, Environmental Quality Laboratory
Takikawa,Yuichi	Faculty of Agriculture, Shizuoka University,Shziuoka, Japan
Walthall, Charles	USDA-ARS, Hydrology & Remote Sensing Laboratory
Zhang, Wenming	Alberta Research Council, Vagerville, Alberta, Canada

PATRICIA D. MILLNER, MICROBIOLOGIST

Summary of Research

Dr. Millner contributes 0.40 FTE to the Methyl Bromide Project (1265-21220-176) and 0.20 FTE to the Farming System Project (1265-21660-001) within SASL, and 0.40 FTE to the Animal Waste Pathogen Lab. **Methyl Bromide Project :** Compost quality and reliability of disease suppression is a current barrier for widespread commercial use of composts by growers. Increased reliability of plant disease suppressiveness among batches of composts is being sought through targeted microbial augmentation coupled with process control management during compost curing. Compost, produced at the BARC composting research facility from our standard farm feedstocks, is inoculated with test BCs during curing in a lab-scale reactor which will provide control of aeration, temperature, and moisture so BCs are not destroyed by these factors. Preliminary evidence indicates that several BCs *(Gliocladium virens, Talaromyces flavus*) tolerate compost well enough to increase their populations during relatively short incubation periods. One deliverable will be a step-by-step protocol for quality-driven production of disease suppressive compost via managed curing. In addition, various means of compost placement and delivery to the root zone, rather than broadcasting across a field, are being examined in the context of other systemic changes in the strawberry production system. The overall goal is to develop a system that uses reduced inputs, increases net farm revenues, while building soil quality and biological buffering against ingress by root and foliar pathogens, pests, and weeds. Trials integrating these crop rotations with commercially available, resistant cultivars, biological control agents targeted against *M. incognita* on tomato, pepper, and strawberry (applied as root dips or drenches at transplant or fall runnering (berries), and custom composts and compost teas will be evaluated for suppression of *M. incognita* and root rots in field trials at Ft. Pierce, FL where organic production and strawberry system studies are in progress. **Farming Systems Project:** Management of organic matter amendments and especially their textural and water holding/filtering capacity on plant/soil/microbial interactions and dynamics will be compared in several intensively managed ecosystems: agricultural, urban rain gardens, and vegetated landfill covers. Enhanced carbon sequestration, reduced greenhouse gas emissions, and protection of water quality are desirable system functions that organic matter amendments can influence. Determining good construction, operation, and management practices requires additional knowledge about these functions. Research will focus on development and testing of organic matter blends that can enhance the desirable functions in each system through microbiorhizal activities.

Publications (1999 to present)

Douds, D.D. Jr. and P.D. Millner. 1999. Biodiversity of arbuscular mycorrhizal fungi in agroecosystems. Agric. Ecosys. Environ. 74: 77-93.

Millner, P. and L. McConnell. 2000. Odor and Other Air Quality Issues Associated with Organic and Inorganic By-Products. Soil Science Society Special Publication.

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Thompson, W., P. Leege, P. Millner, and M. Watson. 2001. Test Methods for the Examination of Compost and Composting. USDA, Conservation Research Report (in press).

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DANIEL P. ROBERTS, MICROBIOLOGIST

Summary of Research

Dr. Roberts is the Lead Scientist and contributes 0.80 FTE to the Methyl Bromide Project (1265-21220-176) and contributes 0.20 FTE to the Cover Crop Project (1265-21000-138). Research directed at developing biological control bacteria and fungi for suppression of important soilborne pathogenic fungi and nematodes is conducted. Bacterial and fungal isolates are screened for suppression of *Pythium ultimum, Rhizoctonia solani*, and *Meloidogyne incognita* on cucumber, *M. incognita* on tomato and pepper, and *Gaeumannomyces graminis* var. *tritici* on wheat. Candidate strains are applied as seed treatments individually or in combination with other candidate strains. A number of bacterial and fungal isolates have been found that suppress these pathogens with the exception of *M. incognita* on tomato. Certain combinations of these microbes decrease disease suppression compared to suppression when used alone. Research is also conducted to determine the means by which beneficial bacteria associate with seeds and roots during suppression of soilborne plant pathogens. *pfkA, sdhA, rpiA, and aceF* were demonstrated to be important for colonization of subterranean plant parts by the biological control bacterium *Enterobacter cloacae*. These genes encode important enzymes in glycolysis, the pentose phosphate pathway, and the tricarboxylic acid cycle. This establishes these pathways and the catabolism of carbohydrates and other reduced carbon compounds as important for colonization of plant surfaces. The regulatory genes *cyaA* and *degS* were also determined to be important for colonization of cucumber roots by *E. cloacae*.

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JOHN R. TEASDALE, SUPERVISORY PLANT PHYSIOLOGIST

Leadership: Dr. Teasdale provides leadership to research programs in the Sustainable Agricultural Systems Lab. He also provides leadership to the ad hoc organic farming research program at BARC that includes an on-farm component that has been operating since 1999, a newly formed group exploring the linkage between production and food nutrition/quality/safety, and development of certified organic production fields for on-station research at BARC.
Personal research: Dr. Teasdale conducts research for three projects: 0.5 FTE on the Weed Biocontrol Project (1265-22000-062), 0.25 FTE on the Farming System Project (1265-21660-001), and 0.25 FTE on the Cover Crops Project (1265-21000-138). Research on the Weed Biocontrol Project is focused on developing cover crop-based integrated weed management systems for sustainable production. This research also includes understanding responses of weed emergence to tillage and cover crop residues (assisted by Research Associate J. Radhakrishnan and Support Scientist P. Pillai). Research Associate J. Radhakrishnan also has identified vinegar as an herbicide and is developing this concept. Research on the Farming System Project involves determining weed seed bank dynamics in these long-term plots (conducted by Support Scientist R. Mangum) and detailed studies of weed seed survival and weed competitiveness by HQ Research Associate S. Ullrich. Research on the Cover Crop Project supports development of cover crop management for sustainable production systems.

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SARA E. WRIGHT, SOIL SCIENTIST

Summary of research

Dr. Wright contributes 100% to the Soil Microbiology Project (1265-12000-025). Research investigates the role of glomalin, a glycoprotein produced by arbuscular mycorrhizal (AM) fungi, in soils. Glomalin is extracted and compared from a number of soils derived from a variety of geographic regions, crop rotational species, and tillage regimes. The relationships between glomalin and soil aggregate stability in these soils is explored. Comparisons of extractions of humic and fulvic acids and glomalin by nuclear magnetic resonance spectroscopy are performed to determine relative abundance in extractable soil organic matter. This research will explain why the contribution of AM fungi to soil organic matter was not detected by the numerous scientists who have spent their careers investigating humic substances. We have begun to assess production of AM fungi across the soil fertility gradient within an upland old-growth tropical rainforest at the La Selva Biological Station. We quantified glomalin pools across the soil nutrient gradients within the forest and are developing techniques to use glomalin as a bio-indicator for mycorrhizal biomass.

Publications (1999 to present)

Wright, S. F. and A. Upadhyaya. 1999. Quantification of arbuscular mycorrhizal fungi activity by the glomalin concentration on hyphal traps. Mycorrhiza 8:283-285.

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AGENCY ABBREVIATIONS

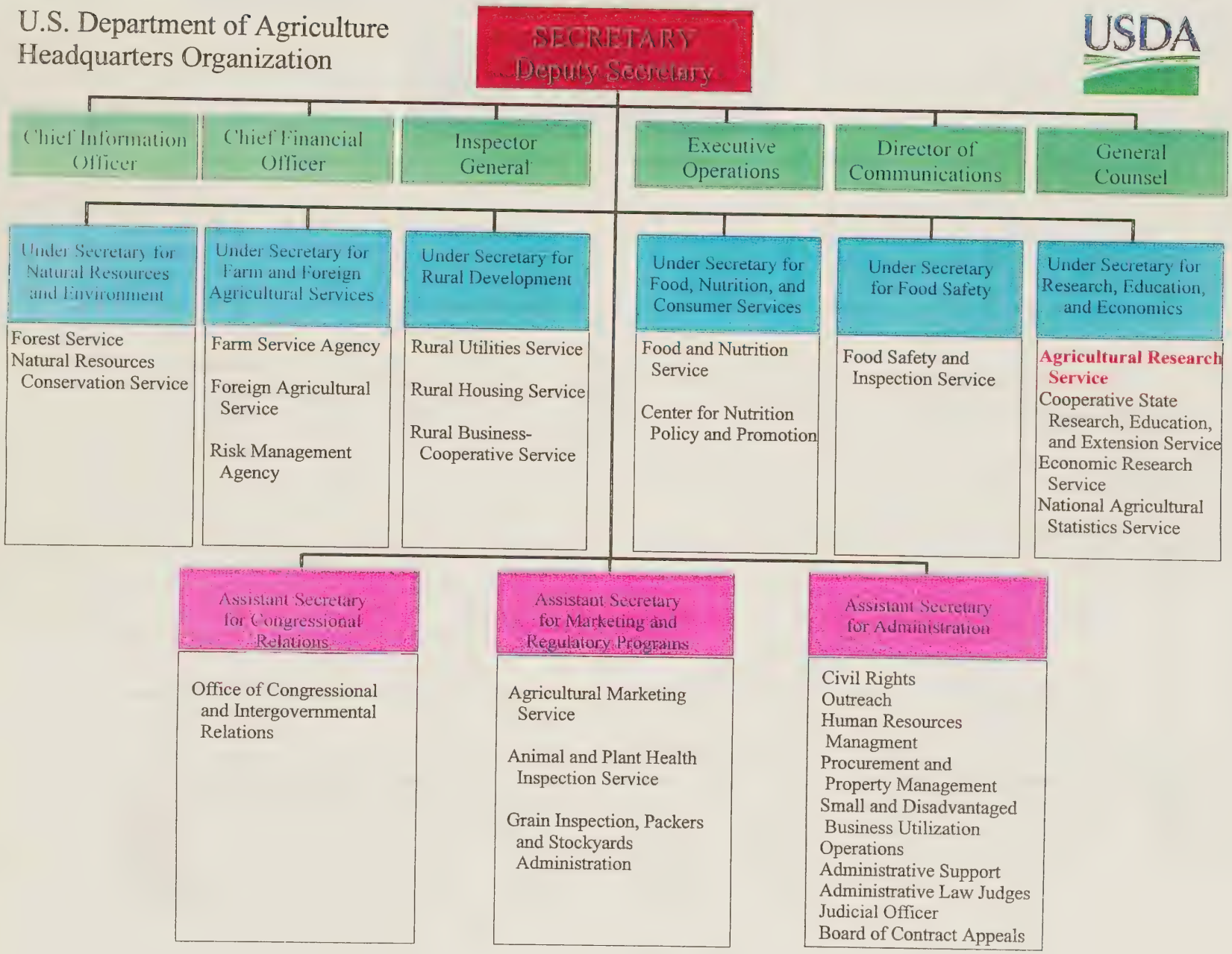
AAD	Associate Area Director
AAO	Area Administrative Officer
ABFO	Area Budget & Fiscal Officer
AC	Administrators Council
ACS	Area Computer Specialist
AD	Area Director or Agriculture Department; e.g., AD-332
ADA	Associate Deputy Administrator
ADO	Authorized Departmental Officer
ADODR	Authorized Department Officer's Designated Representative
ADOL	Avian Disease & Oncology Laboratory
ADP	Automated Data Processing
AE	Architectural Engineer
AES	Agricultural Experiment Station
AFM	Administrative and Financial Management
APHIS	Animal Plant Health Inspection Service
APP	Annual Performance Planning
ARMPS	Annual Research Management Planning System
ARS	Agricultural Research Service
ARSITS	Agricultural Research Service Invention Tracking System
ASAP	As Soon As Possible
ASST AD	Assistant Area Director
B&F	Budget & Fiscal
BA	Beltsville Area
BARC	Beltsville Agricultural Research and Development
BARD	Binational Agricultural Research and Development
BPA	Blanket Purchase Agreement
BPMS	Budget Program Management Staff
BRDC	Biotechnology Research & Development Corporation
CAD	Contracting & Assistance Division
CAT	Category
CD	Center Director
CEPS	Cluster Environmental Protection Specialist
CFC	Combined Federal Campaign
CNRC	Children's Nutrition Research Center
COB	Close of Business
CR	Civil Rights
CRADA	Cooperative Research and Development Agreement
CRAS	CRIS Resource Allocation Schedule
CRIS	Current Research Information System
CS	Contract Specialist
CSREES	Cooperative State Research Education Extension Service
CSRS	Civil Service Retirement System
CTAP	Career Transition Assistance Program
CWU	CRIS Work Unit
CY	Calendar Year
DA	Deputy Administrator

DAD	Deputy Area Director
DAEA	Designated Area Ethics Advisor
DE	Data Entry
EAP	Employee Assistance Program
EEAC	Equal Employment Advisory Council
EEO	Equal Employment Opportunity
EOD	Enter on Duty
EPF	Employee Performance Folder
ERB	Employee Relations Branch
ERRC	Eastern Regional Research Center
ERS	Economic Research Service
FAS	Foreign Agricultural Service
FEGLI	Federal Employees' Group Life Insurance
FEHB	Federal Employees' Health Benefits
FERS	Federal Employees' Retirement System
FMD	Financial Management Division
FOIA	Freedom of Information Act
FPL	Full Performance Level
FTE	Full Time Equivalent
FY	Fiscal Year
FYI	For Your Information
GBL	Government Bill of Lading
GCP	Grade/Category Problem
GOV	Government Owned Vehicle
GPO	Government Printing Office
GPRA	Government Performance & Results Act
GS	General Schedule
GSA	General Services Administration
HNRC	Human Nutrition Research Center
HPRL	High Priority Requirements List
HQ	Headquarters
HRD	Human Resources Division
HRM	Human Resource Management
IDP	Individual Development Plan
IR	Invention Report
IRC	Indirect Research Costs
IS	Information Staff
LAO	Location Administrative Officer
LC	Location Coordinator
LD	Laboratory Director
LOTS	Location Obligation Tracking System
LS	Lead Scientist
LWOP	Leave With Out Pay
MAP	Modernization of Administrative Process
MARC	Meat Animal Research Center
MSA	Mid-South Area
MU	Management Unit
MWA	Midwest Area
NAA	North Atlantic Area
NADC	National Animal Disease Center
NAL	National Agricultural Library

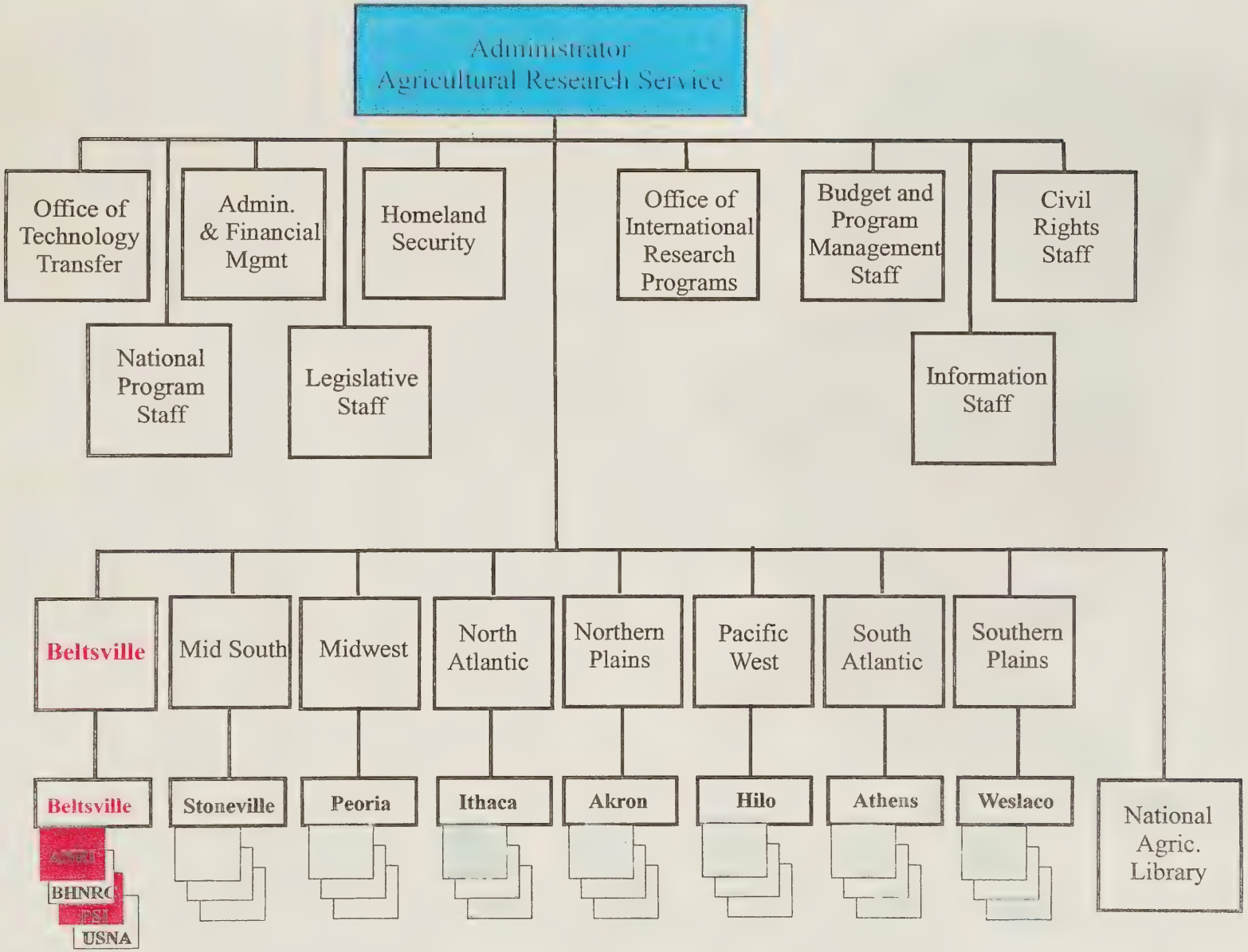
NAS	National Agricultural Statistics Service
NCAUR	National Center for Agricultural Utilization Research
NCRPIS	North Central Regional Plant Introduction Station
NFC	National Finance Center
NFMP	National Facilities Management Plan
NPA	Northern Plains Area
NPL	National Program Leader
NPPC	National Patent Program Coordinator
NPS	National Program Staff
NSAC	National Secretarial Advisory Council
NSRC	National Swine Research
NSRC	National Swine Research Center
NSTL	National Soil Tilth Laboratory
NTE	Not to Exceed
OA	Office of the Administrator
OCI	Office of Cooperative Interactions
OGC	Office of the General Counsel
OGE	Office of Government Ethics
OICD	Office International Cooperation & Development
OIG	Office of Inspector General
OIRP	Office of International Research Programs
OPM	Office of Personnel Management
OSQR	Office of Scientific Quality Review
OTT	Office of Technology Transfer
OWCP	Office of Workers' Compensation Program
PA	Program Analyst
PAA	Program Analyst Assistant
PAO	Procurement Assistance Officer
PASTG	Program Administrative Support Task Group
PC	Personal Computer
PCMS	Purchase Card Management System
PD	Position Description
PFT	Permanent Full Time
PI	Principal Investigator
PIADC	Plum Island Animal Disease Center
PIP	Performance Improvement Plan
PM	Program Management
POV	Personal Owned Vehicle
PPT	Permanent Part Time
PSP	Position Staffing Plan
PWA	Pacific West Area
QSI	Quality Step Increase
R&D	Research & Development
R&M	Repair and Maintenance
RAP	Research Apprenticeship Program
RARC	Russell Agricultural Research Center
REE	Research, Education & Economics
RGEG	Research Grade Evaluation Guide
RIF	Reduction In Force
RIG	Remain In Grade
RL	Research Leader

RMIS	Research Management Information System
RPB	REE Policy Branch
RPES	Research Position Evaluation System
RPS	Research Project Statement
RSA	Research Support Agreement
RSB	REE Services Branch
RU	Research Unit
SAA	South Atlantic Area
SAMS	Salary Allocation Management System
SCD	Service Computation Date
SEC	Secretary
SES	Senior Executive Service
SEU	Special Examining Unit
SIP	Summer Intern Program
SIR	Statutory Invention Registration
SLP	Salary Lapse Policy
SOP	Standard Operating Procedures
SPA	Southern Plains Area
SRC	Shared Research Costs
SRRC	Southern Regional Research Center
ST	Scientific and Technical Positions
STEP	Student Temporary Employment Program
STP	Strategic Plan Codes
SY	Scientists
T&A	Time & Attendance
TFT	Temporary Full Time
TPS	Target Percent in Salaries
TSP	Thrift Savings Plan
UPG	Upgrade
USDA	United States Department of Agriculture
USDFRC	U.S. Dairy Forage Research Center
WGI	Within Grade Increase
WHNRC	Western Human Nutrition Research Center
WRRC	Western Regional Research Center
WSB	Western Services Branch

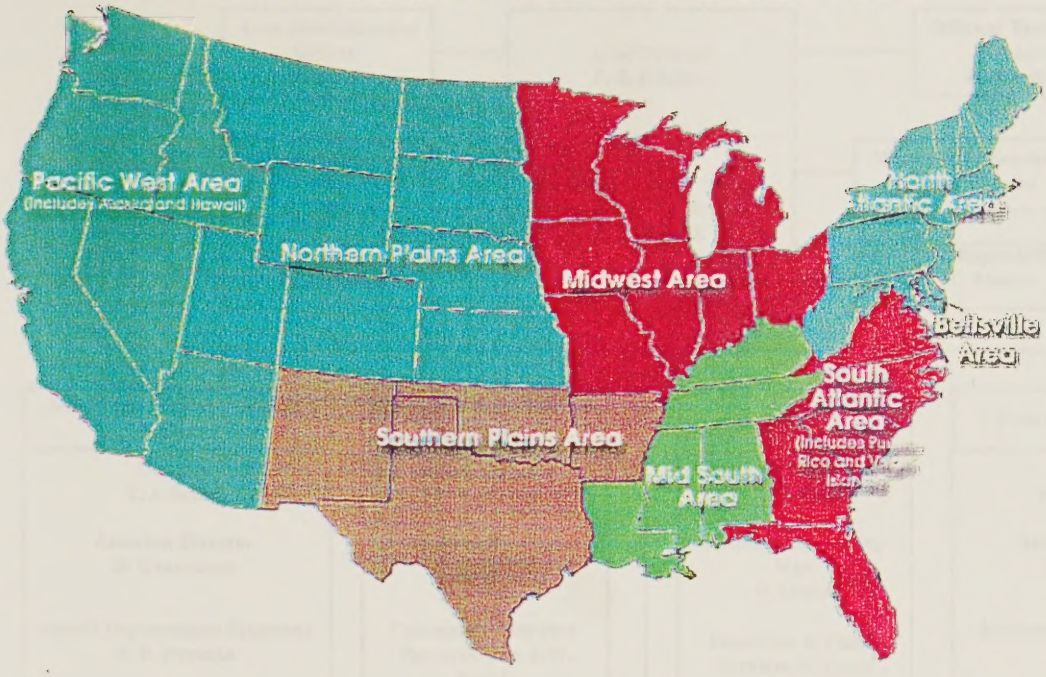
U.S. Department of Agriculture Headquarters Organization



Agricultural Research Service -- Organization



ARS Research Locations



- Beltsville Area
  Beltsville, MD. & Washington D.C.
- Mid South Area
  Alabama, Kentucky, Mississippi, Lousiana, Tennessee
- Midwest Area
  Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, Wisconsin
- North Atlantic Area
  Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
- Northern Plains Area
  Colorado, Kansas, Montana, North Dakota, Nebraska, South Dakota, Utah, Wyoming
- Pacific West Area
  Arizona, California, Hawaii, Idaho, Nevada, Oregan, Washington
- South Atlantic Area
  Florida, Georgia, North Carolina, Puerto Rico, South Carolina, Virginia, Virgin Islands
- Southern Plains Area
  Arkansas, New Mexico, Oklahoma, Texas, Panama
- International Locations

USDA, AGRICULTURAL RESEARCH SERVICE
BELTSVILLE AREA

Area Director
P. E. Johnson

Associate Area Director
R. F. Korcak

Area Administrative Officer
(Vacant)

Physical Security Unit
D. Thessen

Security
C. Randolph

Office of Technology Transfer
H. Danforth

Biometrical Consulting Serv
B. Vinyard

Civil Rights Office
C. Moore

Animal and Natural Resources Institute

Director
T. J. Sexton

Associate Director
D. Granstrom

Animal Improvement Programs
H. D. Norman

Animal Manure & By-Products
L. Gasbarre (Acting)

Animal Waste Pathogen
M. Perdue

Environmental Quality
C. Hapeman

Food Technology & Safety
M. Solomon

Bovine Functional Genomics
A. Capuco (Acting)

Biotechnology & Germplasm
K. Zuelke

Growth Biology Laboratory
J. P. McMurtry

Hydrology and Remote Sensing
W. Rawls

Immunology & Disease Resistance
J. K. Lunney

Instrumentation and Sensing
Y. R. Chen

Parasite Biology, Epidemiology, & Systematics, M. Jenkins

Research Animal Services
K. Hummel

Sustainable Agricultural Systems
J. Teasdale

Veterinary Service
W. Hare

Beltsville Human Nutrition Research Center

Acting Director
E.W. Harris

Assistant Director
E.W. Harris

Community Nutrition Research Grp, E.W. Harris

Diet & Human Performance
B. Clevidence

Food Composition
J. Harnly

Food Surveys Research Group
A. Moshfegh

Nutrient Data
J. Holden

Nutrient Requirements & Functions, J. Urban

Phytonutrients
E. Harrison

U. S. National Arboretum

Director
T. S. Elias

Admin & Marketing Mgr.
D. Laster

Education & Visitor Services, N. Luria

Facilities Unit
R. Gentry

Floral & Nursery Plants Res. Unit, J. Hammond

Gardens Unit
E. Ley

Plant Sciences Institute

Director
W. W. Collins

Associate Director
J. Anderson

Alternate Crops & Systems
V. Reddy

Bee Research
M. Feldlaufer

Chemicals Affecting Insect Behavior, J. Aldrich

Fruit
F. Hammerschlag

Insect Biocontrol
M. Greenstone

Molecular Plant Pathology
R.E. Davis

National Germplasm Resources
A. K. Stoner

Nematology
D. J. Chitwood

Produce Quality and Safety
K. Gross

Soybean Genomics & Improve.
P. B. Cregan

Systematic Botany & Mycology
A.Y. Rossman

Systematic Entomology
M. Schauff

Vegetable
A. Mattoo

Facilities Management & Operations Division

Deputy Area Director
J. N. Van de Vaarst

Engineering & Planning
F. Messineo

Farm Operations Branch
L. Benedict

Operations & Maintenance
D. Nolen

Safety, Occupational Health & Environment, D. Prevar

Utility Services
W. Beverley

October 2002